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ABSTRACT

This guide was developed to assist instructors in electronics technologies in presenting broadly applicable nontechnical (often called quality of work life--QWL) skills, such as interpersonal and group process skills, problem solving and decision making, planning, communications, reasoning skills, and organizational management skills. The guide provides examples of instructional strategies and student learning activities that can be used to integrate such objectives into existing programs. It also identifies supportive resources and indicates where they can be used to aid in developing QWL skills. The following traditional instructional methods are identified and discussed in the guide: the textbook-workbook approach, the lecture method, the discussion method, the demonstration method, and the show-and-tell method. The following additional approaches also are discussed: the project method, the problem-solving method, the discovery method, research and experimentation, individualized instruction, performance-based instruction, the contract method, peer teaching and peer tutoring seminars, the instructional worksheet method, the case-study method, conferences, the business enterprise and entrepreneurship approach, and audiovisual approaches. Finally, the following experiential approaches are discussed: cooperative education and the on-the-job or on-site approaches. The guide includes selected resources on quality of work life objectives; on the instructional approaches; and on selected labor, business, and industry contacts.

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Research and Development Series No. 255

SKILLS FOR THE CHANGING WORKPLACE: AN ELECTRONICS INSTRUCTOR'S GUIDE

by

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CONTENTS

FOREWORD v

EXECUTIVE SUMMARY vii

PURPOSES AND RELATED BACKGROUND INFORMATION 1

- Why Was This Guide Developed? 1
- What Are the Purposes of the Guide? 1
- Why Is It Important to Consider the Ideas in This Guide? 1
- For Whom Is This Guide Intended? 3
- What "Raw Materials" Were Used to Develop the Guide? 3
- What Does the Guide Include? 4

QUALITY OF WORK LIFE TEACHING AND LEARNING OBJECTIVES 5

INFUSING OBJECTIVES INTO INSTRUCTION 11

- Infusion Rather Than Delusion 11
- Instructional Approaches: A Cafeteria of Possibilities 11
- Some Introductory Thoughts on Implementation and Evaluation 13

TRADITIONAL INSTRUCTIONAL APPROACHES 15

- Textbook-Workbook Approach 15
- Lecture Method 17
- Discussion Method 19
- Demonstration Method 21
- Show-and-Tell Method 22

ADDITIONAL INSTRUCTIONAL APPROACHES 23

- Project Method 23
- Problem-solving Method 26
- Discovery Method 28
- Research and Experimentation 30
- Individualized Instruction and Performance-based Instruction 32
- Contract Method 35

Peer Teaching and Peer Tutoring 37
Seminars 39
Instructional Worksheet Method 41
Case-Study Method 43
Conferences 45
Business Enterprise and Entrepreneur Approach 47
Audiovisual Approaches 48

EXPERIENTIAL INSTRUCTIONAL APPROACHES 49

Cooperative Education 49
On-the-Job and Other On-site Approaches 51

SELECTED RESOURCES 53

Resources on Quality of Work Life Objectives 53
Resources on Instructional Approaches 65
Resources on Labor, Business, and Industry Contacts 79
Important Addresses 80

FOREWORD

To function effectively on the job, workers increasingly need improved skills in such broadly applicable, nontechnical areas as interpersonal relations and group processes, problem solving and decision making, planning, communications, reasoning, and business organization and management. While some of these skills may be addressed in vocational and technical education at the present time, they are seldom an explicit part of the program. Their development is rarely given the amount of emphasis—relative to job-specific skills—that their increasing importance seems to warrant.

This instructional guide was developed to assist instructors in electronics technologies in presenting broadly applicable, nontechnical work skills. The guide also should interest administrators and curriculum development specialists who are concerned with giving students relevant preparation for work.

This document describes some examples of instructional strategies and student learning activities for use in incorporating those types of skills into existing electronics programs. The guide also identifies supportive resources to aid in the development of these broadly applicable skills.

The National Center is deeply indebted to the many individuals who have generously donated their time and insights in developing this guide. We greatly appreciate the invaluable help of the project's technical advisory panel and wish to thank Ralph Folger, Department Chair of Electrical Technologies, Hudson Valley Community College, Troy, New York; Ronald Gepner, Electronics Instructor, Mercer County Community College, Trenton, New Jersey; James O'Hara, Operations Personnel Manager, Matsushita Industrial Company, Franklin Park, Illinois; and Mike Pittman, Curriculum Specialist in Electronics, North Carolina Department of Community Colleges, Raleigh, North Carolina. We also wish to thank Allen Wiant, Research Specialist at the National Center, who assisted in the early stages of the project.

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Finally, we wish to thank the authors, Robert D. Bhaerman, Research Specialist of the National Center, and Larry A. Oliver, Instructor in Electronics Engineering Technology of the Columbus Technical Institute, Columbus, Ohio, for their preparation of the instructional guide. Sharyn Eberhart and Sherri Trayser provided typing support and Janet Kiplinger supervised the editorial review of the final copy.

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EXECUTIVE SUMMARY

Early in 1984, the National Center completed its report *The Changing Workplace: Implications of Quality of Work Life Developments for Vocational Education*. Among other things, the document examined implications of quality of work life (QWL) developments for future skill requirements and their consequences for vocational and technical education policies and programs. The authors—Pratzner and Russell—hoped that the report would lead to a greater understanding of the educational implications of QWL developments by various vocational and technicial educators, including instructional personnel. This report, indeed, lead to the development of this instructional guide for postsecondary school instructors in the electronics technology curriculum.

The instructional guide basically follows the format of standard guides. That is, it includes teaching and learning objectives and a variety of instructor and student activities. Its purpose is to assist instructors in electronics technology by infusing broadly applicable nontechnical objectives—quality of work life skills—into technical curriculum. The guide, therefore, describes examples of instructional strategies and student learning activities that can be used to integrate such objectives into existing programs. It also identifies supportive resources and indicates where they can be used to aid in developing these skills.

On the basis of Pratzner and Russell's report, the following broad skill areas have been targeted in this guide for infusion into existing technical curricula: (1) interpersonal skills, (2) group process skills, (3) problem-solving skills, (4) decision-making skills, (5) planning skills, (6) communication skills, (7) reasoning skills, and (8) organizational and management skills. Within these general categories, a number of more specific objectives also are identified.

The term *infusion process*, simply means that teaching and learning objectives are incorporated wherever possible and whenever the technical curriculum lends itself; that is, attitudes, nontechnical skills, and knowledge become a thread weaving through the curriculum. These objectives do not replace the normal content; however, what in the past may have been implicit in instruction now would simply be made more explicit.

As a result of an analysis by the authors of this guide, the following traditional instructional methods are identified and discussed in the guide: the textbook-workbook approach, the lecture method, the discussion method, the demonstration method, and the show-and-tell method.

The following additional approaches also are discussed: the project method, the problem-solving method, the discovery method, research and experimentation, individualized instruction, performance-based instruction, the contract method, peer teaching and peer tutoring, seminars, the instructional worksheet method, the case-study method, conferences, the business enterprise and entrepreneurship approach, and audiovisual approaches.

Lastly, the following experiential approaches are discussed: cooperative education and the on-the-job or on-site approaches.

The format for presenting each instructional approach is as follows: (1) a brief description, (2) a discussion of procedures, instructor and student roles, and—in some cases—general activities; and (3) guidelines for infusing the objectives—including some examples that point out which quality of work life objectives are relevant. As noted, the second part of the guide includes selected resources on quality of work life objectives; on the instructional approaches; and on selected labor, business, and industry contacts.

PURPOSES AND RELATED BACKGROUND INFORMATION

Why Was This Guide Developed?

In January 1984, working for the National Center for Research in Vocational Education, Pratzner and Russell completed their report on *The Changing Workplace: Implications of Quality of Work Life Developments for Vocational Education*.* The report was based on a review of the literature concerning interviews and observations at nine firms that are recognized leaders in quality of work life (QWL) activities. The authors examined the implications of QWL development for future skill requirements and their consequences for vocational and technical education policies and programs. The report also provided background information to familiarize vocational and technical educators with QWL developments in the workplace. The authors hoped that the report would stimulate further examination and lead to a greater understanding of the educational implications of QWL developments by various vocational and technical educators—including program developers, curriculum specialists, and instructional personnel.

The 1984 report, moreover, led to the development of this instructional guide for postsecondary school instructors in the electronics technology curriculum. Similar guides were developed, as a result of the report, for marketing and distributive education and the automotive curriculum areas at the secondary school level and for business and office occupations programs at the postsecondary level.

What Are the Purposes of the Guide?

Although instructional guides come in differing shapes and sizes, essentially, they follow a similar format. Normally they include teaching and learning objectives, a variety of instructor and student activities, and resource materials that may be used selectively to meet a particular situation. In short, their content "suggests" rather than "prescribes."

This guide follows the standard format. Specifically, its purpose is to assist postsecondary school instructors in electronics technology in the infusion of broadly applicable, nontechnical objectives into their technical curriculum. In addition to describing examples of instructional strategies and student learning activities that can be used to integrate such objectives into existing programs, the guide also identifies supportive resources and indicates where they can be used to aid in the development of these skills.

Why Is It Important to Consider the Ideas in This Guide?

The answer to this question requires a detailed response. First of all, consider the following three brief items from rather diverse sources:

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*F. Pratzner and J. Russell, *The Changing Workplace: Implications of Quality of Work Life Developments for Vocational Education* (Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984).

According to a recent report from the National Academy of Sciences, a blue-ribbon panel of employers, educators, and economists states that "graduates of American high schools need to be adaptable to changes in the workplace more than they need any particular job skill. . . . The adaptability is by far the most important characteristic of the young person entering the workplace."

> from the National Academy of Sciences, *High Schools and the Changing Workplace: The Employers' View* (Washington, DC: National Academy of Sciences, 1984), p. 19-20.

The director of the AFL-CIO Department of Education, points out that "historically, the AFL-CIO . . . urged that vocational education students receive a comprehensive education with emphasis on basic education skills rather than a program that is too job specific."

> from Dorothy Shields, "The History and Value of Organized Labor's Linkage with Vocational Education." A Staff Development Seminar presentation (Columbus: The National Center for Research in Vocational Education, The Ohio State University, 6 August 1984), p. 9.

According to a recent report, "The proliferation of high technology industries and their products is far more likely to reduce the skill requirements of jobs in the U.S. economy than to upgrade them. . . . The educational implications of high technology are that a solid basic education rather than narrow vocational preparation will become more important in the future."

> from H. M. Levine and R. W. Rumberger, *The Educational Implications of High Technology* (Palo Alto: Institute for Research on Finance and Governance, 1983), p. 12-13.

As these items illustrate, a growing consensus exists in the management, labor, and education sectors that work will increasingly require individuals who are able to initiate and respond to changes in work organization. Sociotechnical developments in the workplace—social developments and technological changes in the nature of jobs and organization of work—have unknown consequences for job skills. As a result, both colleges and secondary schools must emphasize the development of skills that are broadly applicable in a variety of settings. Pratzner and Russell indicate that such skills include interpersonal relations and group processes, problem solving and decision making, planning, communication, reasoning, and business organization and management.

To serve the needs of today's young adults who must work in tomorrow's jobs, vocational and technical educators should emphasize occupational adaptability in their programs and should develop approaches for doing so. Developing such skills can complement the teaching of occupationally specific knowledge. Accomplishing both purposes calls for refocusing instructional strategies and learning activities and for infusing them into vocational and technical education classrooms and laboratories.

According to Pratzner and Russell, two widely held—but false—assumptions about the teaching of nontechnical skills may be impeding our efforts to infuse them into existing programs. One is that these skills are most effectively taught through a combination of lecture and listening. The second is that vocational and technical education can do little to develop these skills. Nevertheless, no basis exists for the belief that skills such as problem solving or decision making are best learned through lecturing. In fact, experience suggests that lecturing about these skills is probably the least effective means of presenting them. Instead, students must be provided with a range of opportunities to apply these skills. Indeed, the more opportunities given to students to practice

them and the more realistic the opportunities are, the more effective the teaching will be. Also, given such instruction, students are far more likely to exhibit sustained interest and involvement.

While vocational and technical education have a shared responsibility with other training programs to contribute to the development of these skills, they are unique among educational programs in their potential for so doing. This is because they provide unparalleled opportunities for hands-on approaches and for extensive application. Unfortunately, this potential is routinely overlooked in our continual pursuit of specialized skill development.

In summary, the Education Commission of the States lists nine job skills that will be necessary as we move into the last decade of this century. A majority of these skills are relevant to the quality of work life skills stressed in this guide. They are as follows:

- Evaluation and analysis skills
- Critical thinking
- Problem solving—including mathematics
- Organizational and reference skills
- Synthesis
- Application to new areas
- Creativity
- Decision making with incomplete information
- Communication skills in many modes*

For Whom Is This Guide Intended?

In addition to postsecondary school instructors in the electronics technology, this guide should interest administrators and curriculum specialists at the local, State, and regional levels and any other educator concerned with providing students with up-to-date and relevant preparation for work.

What "Raw Materials" Were Used to Develop the Guide?

Initially, the Educational Resources Information Center (ERIC) database was searched to acquire relevant curriculum materials and instructor's guides. Many of the documents identified in the ERIC search were available at the Research Library of the National Center for Research in Vocational Education. In addition, members of the project's technical advisory panel submitted a number of useful resources. Lastly, several textbook publishing companies demonstrated their support of this activity by contributing texts, workbooks, and related materials.

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*Education Commission of the States, *Information Society* (Denver: Education Commission of the States, 1982)

What Does the Guide Include?

Before turning to the information itself, it is important to reiterate what this guide is—and what it is not. It is a "sampler" in that it includes many objectives, activities, and resources that instructors might wish to consider in their teaching. But it is not, by any means, an encyclopedia; it is far from complete. Teachers will definitely want to discover and use other related objectives, additional learning activities, and supplementary resources. For example, while the instructional guide does not devote a separate section to computer technology, it is clear that the future holds a great deal of involvement with the classroom use of microcomputers, hardware, and software of various types. As you use the guide, you undoubtedly will see many places where the use of computers can be integrated into various instructional approaches.

Again, the guide is suggestive; it is not prescriptive. Finally, it should be remembered that this is a guide; it is not a curriculum. It may, however, help in complementing many of the technical skills taught in the existing curriculum. It will be useful because, as students move into the reality of the changing workplace, quality of work life and participative work environment nontechnical skills will most likely be part of that workplace.*

*The terms *quality of work life*, *participative work environment*, and *nontechnical skills* are often used interchangeably. Such is the case in this guide where each of these terms is used frequently. The meaning of these terms is implicit in the teaching and learning objectives delineated in the following section.

QUALITY OF WORK LIFE
TEACHING AND LEARNING OBJECTIVES

In their report on the changing workplace, Pratzner and Russell* identify a number of non-technical skill areas essential for success in business and industry. (See figure 1, at the end of this section, adapted from that earlier report.) On the basis of that synthesis, the following eight broad *teaching and learning objectives* have been adapted for use in this instructional guide:

1. To infuse *interpersonal skills* into the curriculum
2. To infuse *group process skills* into the curriculum
3. To infuse *problem-solving skills* into the curriculum
4. To infuse *decision-making skills* into the curriculum
5. To infuse *planning skills* into the curriculum
6. To ensure that *communication skills* are integrated into the curriculum
7. To ensure that *reasoning skills* are integrated into the curriculum
8. To ensure that *organizational and management skills* are integrated into the curriculum

Within these general categories, the following specific learner objectives can be readily identified:

1. **Interpersonal skills**
   - To work effectively under different kinds of supervision
   - To work without the need for close supervision
   - To be on time for activities and appointments
   - To work effectively when time and pressure are critical factors for success
   - To see things from someone else's viewpoint
   - To engage appropriately in social interactions
   - To be responsible for the effects of one's own judgments and actions

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*Pratzner and Russell, *The Changing Workplace,* pp. 22-23.

- To plan, conduct, and complete activities at one's own initiative
- To speak with others in a relaxed, self-confident manner
- To initiate task-focused conversations with others

2. **Group process skills**

- To work cooperatively as a team member
- To work effectively with people of different personalities
- To explain persuasively the rationale underlying judgments and actions arrived at by a group
- To coordinate one's activities with others
- To instruct or direct someone in the performance of a specific task
- To demonstrate how to perform a specific task
- To assign others to carry out specific tasks
- To join in and draw others into task-focused conversations
- To plan, convene, lead, and manage meetings
- To lead a group to resolve disputes in the opinions or positions of its members in order to achieve a consensus
- To follow established procedures for group participation and decision making

3. **Problem-solving skills**

- To identify the existence of a problem, given a specific set of facts
- To function effectively in the face of ambiguity
- To ask appropriate questions to identify or verify the existence of a problem
- To enumerate the possible causes of a problem
- To formulate alternative statements relating a problem to its possible cause
- To identify important information needed to solve a problem
- To generate possible alternative solutions
- To describe the application and likely consequences of alternative solutions
- To compare the application and likely consequences of alternative solutions and select a solution that presents the best course of action

4. **Decision-making skills**

   - To estimate the potential likelihood of some event's occurrence and probable consequences
   - To project resource requirements for alternative scenarios
   - To determine the relevance and quality of available data and information
   - To identify needed information and information that could be located or generated
   - To delineate assumptions underlying various options
   - To use appropriate processes in order to facilitate making a decision

5. **Planning skills**

   - To set priorities in which several tasks could be accomplished
   - To set the goals or standards for accomplishing a specific task
   - To enumerate a set of possible activities needed to accomplish a task
   - To determine how specific activities will assist in accomplishing a task
   - To select activities to accomplish a specific task
   - To determine the step-by-step process by which a specific task may be accomplished
   - To estimate the time required to accomplish a specific task
   - To select materials and resources needed to perform a specific task
   - To revise or update activities and plans periodically in order to accomplish a specific task

6. **Communication skills**

   - To choose appropriate words that convey accurate meanings in both writing and speaking
   - To gather information or data from books, manuals, and other printed documents
   - To read graphs, charts, and tables—as well as memos and forms—in order to obtain factual information
   - To compose written directives, memos, and reports
   - To speak fluently and effectively with both individuals and groups
   - To restate or paraphrase a conversation to confirm one's understanding of what was said

- To ask appropriate questions to clarify another's written or oral communication
- To listen carefully and take accurate notes from spoken conversation

7. **Reasoning skills**

- To generate or conceive new ideas
- To use previously learned knowledge and skills in a new situation
- To explain the main idea in another's written or oral communication
- To recall ideas, facts, and information accurately
- To organize and express ideas rapidly in oral and written discourse
- To interpret ideas or facts in terms of one's personal viewpoint or values
- To state a position clearly and defend it
- To distinguish between fact and opinion in one's own and in others' written and oral communication
- To compile notes, ideas, and materials from several sources into a single report
- To observe--and ask questions about—another's performance in order to identify whether the performance is satisfactory or whether it needs improvement

8. **Organization and management skills**

- To understand and apply concepts of business economics
- To understand and apply concepts of business operation
- To understand and apply concepts of management
- To understand and apply concepts of statistical quality control
- To understand the quality of work life philosophy, as well as its rationale, history and development, concepts and approaches, and methods and techniques

Skill Area	Reason for Need in Business/Industry
I. Group Problem Solving	Group problem solving is one of the primary modes for change and improvement in high-involvement companies
A. Interpersonal Skills	
• Self-directed	To enhance flow of ideas
• Flexible	To reduce need for supervision/inspection
• Assertive	To change as market conditions change
• Open	To reduce inefficiencies due to personal conflicts
• Curious to learn	To reduce nonproductive time
• Able to share/teach	To profit from people's individual motivations
• Responsible	To promote sharing/cooperation
• Understanding of behavior	To encourage continuous improvement
	To facilitate individual and corporate growth
	To acknowledge and encourage input from workers at all levels
B. Group Process Skills	
• Role theory/norm theory	To have similar goals held by all to increase the possibility of reaching goals
• Techniques of structuring discussions	All workers need to serve as leaders in various activities because of need for flexibility
• Cooperative attitude	Fifty people can work together and not just independently
• Leadership	Cooperation proves more productive than competition
	To encourage equal participation
C. Problem-solving Skills	
• Problem identification	To be rational in addressing problems
• Problem-solving process steps	To be systematic and comprehensive in addressing problems
• Data collection and analysis	To address the correct issue
	To generate the critical information necessary for solving problems
D. Decision Making	
• Risk assessment	If management is pushed to lower levels, decision making goes on at lower levels
• Data review	Organizational philosophy (values) shared with all workers enhances mutual goal development
• Identifying gaps in information	
• Values	

Skill Area	Reason for Need in Business/Industry
D. Decision Making (continued)	To be aware of information relevant to a decision
• Process models/ choice models	To understand the importance associated with various factors within a decision
	To make better decisions with improved results
E. Planning	
• Goal setting	If management is pushed to lower levels, planning goes on at lower levels
• Establishing measurable action steps	If the process is right, product will end up "right"
	Feedback is necessary for continued improvement
F. Communication	
• With individuals	Presentation of own and the group's ideas is required for management action
• With groups	Group work rather than individual work is the mode
• Presentation skills	Necessary to listen if want to learn from others
• Verbal skills	Change requires sharing, discussing, analyzing, persuading, etc.
• Writing skills	
• Listening skills	
G. Thinking/Reasoning	
• Generating alternatives	If all are to contribute, all must think effectively and creatively
• Estimate and approximate	Decision making, planning, problem solving all require critical thinking, and these skills will be required of all levels of workers, not just management
• Giving and getting meaning	
• Collecting information	
• Classifying	
• Finding patterns	
• Generalizing	
• Sequencing and scheduling	
• Using Criteria	
• Reshaping information	
• Judging information	
• Communicating effectively	

Figure 1. Nontechnical skill areas and their need in business and industry

SOURCE: Pratzner and Russell, *The Changing Workplace,* pp. 47-53.

Skill Area	Reason for Need in Business/Industry
II. Organization and Management	All workers share more of the management responsibilities in high-involvement companies
A. Business Economics	
• Relationships between costs and income	To act as a team and know how individual effort fits in
• Market standing/ environmental conditions	To enhance ability to change as called for
• Basic economic theory	To encourage productivity through incentives and information sharing
• Reward structure	To reduce waste, duplication
B. Business Operations	
• Relationships between function systems	To encourage acting as a whole To reduce duplication of effort
• Coordination of resources	To provide feedback, information for correction purposes To enhance appropriate assignment of resources to maximize results as a whole
C. Management	
• Management theory	To exchange information effectively
• Relationships between performance and other factors	To motivate and lead coworkers To attain desired performance To facilitate workers' quality of daily activities and long-range career goals
• Models of communication	To improve attendance; reduce turnover, sabotage, grievances
• Power/control/ authority/ delegation	To attain improved union/management relations To reduce stress
• Human resource development	To tap knowledge of line workers To improve and change continuously as needed
• Feedback/appraisal	To avoid necessity for resolving same problem
• Job analysis	To enhance match between technology, people, and procedures/policy
• Change processes	To determine if goals have been met, should be modified, expanded, etc.

Skill Area	Reason for Need in Business/Industry
D. Statistical Quality Control	
• Sampling	To improve quality, reduce defects, reduce waste of time and measures
• Quality standards	To identify and analyze problems
• Cause and effect	To improve productivity, efficiency
• Graphs and charts	
• Data analysis	
• Mathematics and statistics	
E. Introduction to QWL	
• Definitions of terms and concepts	To enhance understanding of the need for group process and organizational management skills
• Philosophy	
• Role of QWL at various levels in companies	
• Union/nonunion involvement	

Figure 1—*continued*

INFUSING OBJECTIVES INTO INSTRUCTION

Infusion Rather Than Delusion

It would be a delusion to think that a new course, series of courses, or even separate units of a course could be added to the already-crowded electronics curriculum. And perhaps it would be an even greater delusion to think that quality of work life objectives should be added directly on top of existing technical skill objectives. *It is unrealistic to think that these objectives either could or should be treated as "add-ons."*

Instructors simply cannot effectively teach such subject matter content in the abstract. Although it is true that one can lecture or lead a discussion, nontechnical skills need to be practiced in situations similar to—or which could be made similar to—those found in the workplace. Actually practicing these skills in a realistic way is much more likely to be successful than is building a bridge of abstractions. Moreover, most instructors are not experts in group processes or group dynamics. Fortunately, it doesn't take an expert to apply this approach in a practical fashion. It is also fortunate that instructors in electronics technology have many opportunities to integrate these objectives into the daily life of the classroom or laboratory in ways that make sense and are likely to "pay off" in the long run.

What exactly is meant by *infusion*? The term simply means that teaching and learning objectives are incorporated wherever possible and whenever the technical curriculum lends itself; that is, attitudes, nontechnical skills, and knowledge become parallel threads weaving through the curriculum. Although it may not always be seen, the thread is there. These objectives, obviously, are not intended to replace the normal content. Many of them already are being taught—or caught—in many classrooms and laboratories. However, *what in the past may have been implicit in instruction now simply would be made more explicit*. In short, the electronics technology curriculum could be characterized as coffee and the quality of work life objectives as cream. When the two are mixed, they are no longer discernable in their original form.

Instructional Approaches: A Cafeteria of Possibilities

If *the infusion process* can be considered as cream in one's coffee, the variety of available instructional approaches can be compared to a cafeteria. Instructors can, and do, select from many different teaching and learning strategies—either consciously or unconsciously. Sometimes they make a meal of one approach, but—for a more balanced diet—they tend more often to mix their methods. This is as it should be since—to continue the metaphor—instructors need to spice their menus with a variety of flavors.

A search of the literature on instructional guides produced several resources that identify a number of instructional possibilities in the classroom and laboratory. The two most useful resources were *The Industrial Arts Teacher's Handbook: Techniques, Principles, and Methods* and *Instructional Methods in Occupational Education*.* Even though these two books focused on

*D. A. Maley, *The Industrial Arts Teacher's Handbook: Techniques, Principles, and Methods* (Boston: Allyn and Bacon, 1978); D. C. Nystrom, G. K. Bayne, and L. D. McClellan, *Instructional Methods in Occupational Education* (Indianapolis: The Bobbs-Merrill Company, 1977).

industrial arts and occupational education, they were flexible, fairly general in nature, and easily adaptable.

As a result of this analysis, the following *traditional instructional methods* were identified and are discussed in this guide:

- Textbook-workbook approach
- Lecture method
- Discussion method
- Demonstration method
- "Show-and-tell" method

The following *additional approaches* are also discussed:

- Project method
- Problem-solving method
- Discovery method
- Research and experimentation
- Individualized instruction and performance-based instruction
- Contract method
- Peer teaching and peer tutoring
- Seminars
- Instructional worksheet method
- Case-study method
- Conferences
- Business enterprise and entrepreneurship approach
- Audiovisual approaches

Lastly, the following *experiential approaches* are discussed:

- Cooperative education
- On-the-job or on-site approach

These approaches often are not "self-contained"; that is, a *good deal of overlap* is evident among them. For the purpose of this analysis, however, they are separated into categories, as in the works of Maley and Nystrom and their colleagues. It does not matter whether all of the approaches are used or a combination or whether some of the approaches with different terminology are used. The important point is that a wide variety of instructional approaches exist, and hence, a wide variety of opportunities are available to infuse quality of work life objectives into technical instruction.

Some objectives will be more directly related to specific instructional approaches than others; for example, problem-solving skills (see teaching and learning objective #3 in the previous section) have direct relevance to the problem-solving, discovery, and research and experimentation methods. This, of course, would be expected.

Secondly, it is to be hoped that these objectives will become second nature to instructors; that is, eventually they will not even consciously think about the infusion process. For the moment, however, the important idea is that instructors at least *consider* the infusion concept. Ultimately, they may become "true believers" that this type of infusion can—and should—be done in the classroom or laboratory.

Each approach will be closely examined. Following is a brief description of the approach, then a brief note on some of the more important procedures is presented along with a discussion of the more important roles for both the instructor and the student. Most significantly, suggestions concerning *some*—but not all—opportunities for infusing the objectives into instruction are provided. This guide is open-ended in that ideas of one's own based on either personal experiences or those of colleagues can be added. Since this guide is only the "tip of the iceberg," instructors are encouraged to create their own unique examples. For example, as noted earlier, you undoubtedly will want to add examples which deal with the classroom use of computers.

The second part of the guidebook will also provide some additional useful resources. Here, too, others could undoubtedly be added since what is represented here is only a small portion of what is available.

Here, in summary, is the *format* for each instructional approach:

1. Brief description (in an introductory box)
2. Procedures and instructor and student roles (and in some cases, general activities)
3. Asterisks (used to separate the sections)
4. Infusion of the objectives (including some examples that point out which quality of work life objectives are relevant)

Some Introductory Thoughts on Implementation and Evaluation

A typical electronics course catalog entry describes courses in such terms as "detailed mathematical investigation," "presentation of complex number AC-circuit theory," or "step-by-step design procedure." In other content areas, instructors seem able to work into their courses such goals as "developing interpersonal skills," "working cooperatively," "learning to set goals," "being able to describe major management theories," and the like on a routine basis. Why have electronics instructors paid relatively little attention to nontechnical skills?

Perhaps such skills have been neglected in electronics education because, in the past, the typical electronics technician has been hired primarily for one reason, namely, technical competency. He or she has worked on complex circuits or systems, repairing malfunctions, installing new modules, and so forth. This technician, if good enough, might eventually be promoted to designer. Basically, all these activities are conducted in solitary work environments. When involved in some complex repair, calibration, or design activity, days can pass with the worker's being "isolated" from fellow workers. The task requires full concentration.

When technical schools came along, they were staffed, in many cases, by former military technicians who epitomized the highly skilled, specially trained loner. Consequently, textbooks were written, programs developed, and technicians trained with only problem-solving skills development as a goal. Later, schools might have added a communication skills course or perhaps a speech course in an attempt to round out the students and give them some nontechnical skills.

Students often refer to these courses in less than complimentary terms. Some schools—reasoning that the majority of students who take electronics want only electronics—have used the lack of such courses as a selling point. All this, of course, is very unfortunate. Having been in industry as both a technician and an engineer, one of the writers of this guide has noted that,

although technical competency is first and foremost in the mind of the employer when hiring technical people, businesses and industries appreciate someone who can demonstrate good quality of work life (QWL) skills.

A second reason for the lack of emphasis of the QWL skills in the electronics program is the amount of material to be learned. Some authority appears to have decided that a "2-year" associate degree program is sacred. Even though the amount of material in electronics has tripled in the last 15 years, it still must be compacted into the same 2-year program format developed years ago. Many instructors often have a difficult time simply covering all the technical material. As a result, instructors often do not take the time to develop any skills other than problem-solving in the typical electronics program. This guide, which offers instructors some suggestions for infusing these other skills into the already-crowded schedule, can be very valuable—provided the instructor is convinced of the value of the QWL concept. Recognizing this value is that important "first step" needed.

With regard to evaluation, it is unreasonable to believe that any instructor would want to give grades in a course on advanced circuit analysis based on how well the students worked cooperatively as team members. Such grading criteria still seem more appropriate in nontechnical courses. However, if instructors realize that today's technicians need participative work environment skills, then they should have some means of assessing their progress in infusing these skills into the classroom or laboratory. Such evaluation must necessarily be primarily subjective since little time exists for more objective-type evaluations. A list of things to look for might be appropriate. As the course progresses, the instructor might note how well students work in a lab situation without direct supervision, compared to how well they did earlier in the course. Instructors also might compare students' problem-solving abilities on earlier exams with those reflected on later ones. In other words, instructors must know what to look for to assess progress.

Many nontechnical skills can be ascertained by changes in student attitudes. Perhaps, then, some attitudinal survey could be given on the first day of class and again on the last day—with results compared.

It must be admitted that it is a difficult task to feel motivated to monitor nontechnical skill progress when it is not an official class goal and when the students may not even be aware of the goal. In addition, another caution must be mentioned: a slight danger exists that instructors might be tempted to raise students' grades if they are able to show progress in communication skills while their accomplishments in advanced circuit analysis are limited. It must be remembered that the future employer, after all, is buying technical skills in advanced circuit analysis and wants to see grades that reflect such skills. Instructors must keep this in mind, even though they may be attempting to integrate nontechnical skills into a very technical content area. A balanced program and a common-sense evaluation plan, obviously, are the only ways to go.

TRADITIONAL INSTRUCTIONAL APPROACHES

Textbook-Workbook Approach

Everyone is familiar with textbook format and use. It is estimated that textbooks provide the source for 90 percent of instruction; hence, they wield a powerful influence on students. Their essential characteristic is that they are designed as written guides to the subject content of a course of study; their basic task is to present data and information about a specific subject.

Texts frequently present data of a higher order: concepts, rules, and generalizations—as such, their function is as a "presenter." Texts also attempt to establish relationships among data; in this role they serve as "explicators." Textbooks also contain exercises, study questions, and practice materials, although sometimes these are included in a separate workbook. One type, programmed texts, is designed to permit students to proceed at their own pace. Texts frequently are published with accompanying instructors' manuals, supplementary readings, and audiovisual materials.

Textbooks sometimes are used as the basis for an entire course, or they may be used simply as a resource for additional study or outside assignment and reading. While no one correct way exists to use them, it is important to be aware of their value. Their major function is to provide an orderly introduction to a subject field and to give students an organized means of reviewing and reorganizing knowledge. Textbooks and workbooks can be used in conjunction with many other learning strategies and teaching methods.

Traditionally, when using a textbook as the core of a curriculum, instructors proceed from the first chapter to the last, stopping to clarify, explain, elaborate, and make assignments. The role of the students is to study the materials, take notes, ask questions, and complete the assignments. Textbooks and workbooks have their limitations in that they cannot present all that is known about a topic; and depending on the subject matter, they may quickly become out-of-date. Certain types of learning—such as that required for mastering many nontechnical skills—cannot be effectively presented through the printed page; this fact argues against the sole use of and dependency on a single text.

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In general, textbooks and workbooks provide a good method for presenting information about the nontechnical skills that are common to businesses concerned with establishing a participative work environment, especially those skills related to organization and management. Although textbook information could prove helpful in students' understanding of such skills as group processes,

decision making, and planning and reasoning, actual practice using the skills is also desirable. Communication skills (see teaching and learning objective #6) also could be taught using this approach, although the most effective use of this possible strategy would be made in teaching certain organization and management skills relating to business economics, business operations, and management (objective #8). These organization and management skills are involved in more cognitive knowledge-type learning objectives—to which textbooks readily lend themselves.

The textbook-workbook is the primary teaching aid in the 2-year associate degree electronics program as well as 3- and 4-year programs. Realizing that electronics is one of the most involved subject areas, authors of electronics texts have done an excellent job of presenting abstract subject material in an understandable format, particularly to the associate degree student. Consequently, instructors usually outline their courses with the table of contents as a guide. Typically, they will present the material as found in the text, elaborating on the difficult sections and expanding on those ideas that were presented without proof.

As noted, participative work environment skills are not developed directly by the textbook or workbook *per se*. Instead, they concentrate on developing problem-solving skills (objective #3)—and this they do very well if we define the problem in relatively narrow terms, that is, the problem of a mathematical circuit.

Indirectly, however, the instructor can utilize the textbook as a means of developing many nontechnical skills. By making specific assignments from the text, instructors can foster in students the habit of studying on their own without close supervision as well as that of planning and completing activities on their own initiative—thus developing interpersonal skills (objective #1). By assigning topics for class presentation, instructors can develop communication skills (objective #6). Lastly, by requiring that the material be summarized, the instructor will aid the student in acquiring reasoning skills (objective #7), since students will be required to explain the main ideas in the author's writing, organize and express ideas in written discourse, interpret ideas or facts in terms of one's personal viewpoint, compile notes, and the like.

Lecture Method

A lecture is a carefully prepared oral presentation of a subject by a qualified person, either the instructor or an outside resource person. In addition to employing the strictly oral approach, a lecture may be supplemented with a variety of visual aids, illustrations, charts, or handouts; or it may include some sort of demonstration. The lecture method may be the technique to use when topics and goals point toward doing one or more of the following: presenting information in an organized way, identifying or clarifying problems or issues, encouraging further study or inquiry, and/or introducing a new topic. From the student's point of view, lectures can develop content comprehension, improve attitudes, and build knowledge of specific concepts.

Generally speaking, three steps normally are involved when assessing the lecture method as a learning strategy: establishing its need, developing its specific purpose, and determining its applicability to the unit of study. Depending on the purpose of the lecture, the overall procedure and setting may vary somewhat. If the purpose is to present information, for example, the procedure used should enhance student retention and possible note taking. If the purpose is to stimulate the group and lead to possible discussion, care should be taken to see that the setting used does not have a negative effect. Overall, this method is probably one of the most widely used and easily adapted strategies.

When using the lecture method, the instructor must consider the appropriateness of the content, organize the materials, pace the delivery, be sensitive to learner needs, interact as needed, and make any necessary midcourse corrections. In addition to playing the role of a transmitter, the lecturer serves as a stimulator of thought, observer of student behavior, and evaluator of student understanding. In addition to fulfilling the role of receiver, students are questioners and challengers of the material presented as well as organizers of the information.

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Because the lecture is a relatively noninteractive type of learning strategy, the nontechnical skills that can be developed are more limited than some of the other methods. Listening and note-taking skills can certainly be practiced, and, depending on the structure of the lecture and the amount of time spent on questioning and discussion, other nontechnical skill areas may be involved. Although this method can help to explain participative work environment skills to students, additional learning strategies are required to give them skill in practicing these competencies. Lectures can also prove to be an effective way to convey the more cognitive type of knowledge related to organization and management skills (objective #8).

The lecture method in the electronics field is widely used—and just as widely criticized. Most critics say that the mere presentation of facts does not necessarily lead to independent thinking by the learner. This seems to be true, at least for the average and below-average student. In an area such as electronics, the "facts" are the inner workings of various circuits; to understand these workings requires detailed explanations and mathematical reasoning. A good electronics lecture, while filled with facts to be learned, can be very effective because each of these facts is related to other facts sequentially in such a way that understanding the first concept naturally leads to understanding the next. It would be much less of a challenge for a properly prepared student to remember how a class A, emitter bias, common emitter small signal amplifier operates than, for

example, it would be to memorize the birthdays of the first 25 French monarchs. In the first case, a cause and effect relationship exists between several facts; whereas, in the second, a completely unrelated random relationship exists.

Detailed, fact-filled lectures, then, in a course such as electronics, need no apologies. The instructor owes it to the students to have a thorough knowledge of the subject matter; show enthusiasm for it; present it in a clear, organized manner; and motivate students to learn by showing them real-world relevance.

Listening to such lectures develops problem-solving skills (objective #3) and reasoning skills (objective #7) by requiring the listener to do the following: identify important information needed to solve a problem; generate possible alternate solutions; select the best of several possible solutions; generate new ideas; use previous knowledge and skills in a new situation; recall ideas, facts, and information accurately; organize and express ideas rapidly; and compile notes, ideas, and materials from several lectures into a single document useful in succeeding courses and on the job later.

Discussion Method

Discussion is one of the oldest instructional strategies. It is also one of the most popular in that it enables participants to share in the instructional processes in ways that lectures may not permit. Discussion is a verbal exchange of ideas, points of view, and perceptions for the purpose of clarifying and enriching the subject matter. Its purposes are essentially to develop understanding and gain knowledge as well as to modify attitudes.

The purposes of a discussion should be developed by keeping several important items in mind: objectives should be stated clearly, understood accurately by all, and presented in such a way as to determine whether or not the goals can be attained. Its purposes should also be attainable within the time constraints and levels of the participants' understanding.

The following activities should be considered as part of the prediscussion phase: establishing goals, preparing the participants, establishing ground rules, securing the necessary informational resources, and establishing some system to assess the outcomes of the discussion. Activities in the discussion phase include clarifying and presenting the topic, raising questions, involving the participants, regulating the direction of the topic, and recording significant points. The final phase normally includes summarizing the issues, drawing conclusions, and assessing the attainment of goals.

Either the instructor or students can serve as the discussion leader. Whatever the case, the roles of leaders and participants should be understood. During the activity, the discussion leader normally plays the following roles: leads the discussion (as the name implies) by moving it in directions consistent with the purposes; serves as stimulator, questioner, and challenger; serves as regulator of the involvement of each participant; and serves as a facilitator, moderator, and evaluator. Participants likewise have various and, to some degree, similar roles: planning and setting discussion goals, contributing to the content and substance, and evaluating the activity.

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According to the textbooks on teaching techniques, in a properly handled discussion, evidence is presented on the crucial issues of a current problem. This evidence is analyzed and evaluated by the group, and broad statements or generalizations are made. Class discussion is used to develop group agreement on the solution to the problem. Discussion is an excellent means of sifting through the facts to arrive at the theoretical resolution of a problem.

Discussion seems most appropriate when some area of controversy exists. In light of these formal definitions, this method would, on the surface, seem to have little place in the postsecondary, 2-year electronics program. However, here we have been noting formal discussion techniques such as those found in history or sociology classes. In electronics, it may be necessary to take a more limited definition of discussion and determine if it is useful, not in place of, but as part of the lecture and problem-solving techniques.

Discussion—a verbal exchange of ideas, points of view, and perceptions—should be part of every electronics lecture. Instructors should never say, in effect: "Here it is, take it or leave it." Instead they should preface their discussions of circuit equations, solution techniques, and the like with such statements as, "What do you suppose would happen if. . . ?" or "Now what should we do

when. . . ?" or "Does this approach seem reasonable to you and why. . . ?" By doing this at every opportunity, the instructor literally makes the class come alive with discussion. No class can remain passive when the instructor is continually prodding students into a discussion. An occasional intentionally vague or contradictory statement can even be injected to stimulate a thoughtful response. Such discussion techniques as outlined here develop several skills, namely, problem-solving, decision-making, and communication skills (objectives #3, #4, and #6, respectively). Moreover, they also make an instructor interesting and stimulating to hear.

Demonstration Method

Demonstrations normally focus on how something works, how it is made to work, what makes it work, and what happens in the process. Although demonstrations are used primarily in manipulative types of instruction, they are also effective communication tools for both cognitive and affective learning; that is, one can demonstrate both manipulative skills as well as concepts and principles. More often than not, this method involves such additional approaches as lectures, observations, and discussions. The method usually involves some actions, procedures, techniques, and information giving, coupled with vivid communication that goes beyond simply verbal explanations.

Several procedures should be considered in arranging a demonstration, for example, establishing expected outcomes, planning (time, space, equipment, materials), preparing students, preparing the environment, conducting the demonstration, and developing follow-up and evaluation activities. The most important responsibility of the person conducting the demonstration is to communicate either by talking, using a chalkboard, drawing or illustrating schematics, or, in some cases, projecting information (pictures, cutaways, enlargements). Manipulation also occurs through the use of tools, machines, materials, and related objects. The students' activities mainly relate to sensory involvement with the demonstration (seeing, touching, and so forth), analysis of elements and components, and application and use of the information in related projects.

In this approach, the instructor—to enable students to perform according to the requirements of the demonstration—usually fulfills the following roles: interpreter of materials, challenger, stimulator, helper, and assistant. In turn, student roles often include helping to conduct the demonstration and serving as a co-demonstrator along with the instructor.

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Demonstrations are the mainstay of electronics instruction—whether it be instruction in concepts and principles or in manipulative skills. For example, little can be explained in electronics without drawing a schematic, pointing to a voltmeter, or wiring a circuit. Optimum utilization of this technique requires the instructor's experience in making transparencies, handling measuring equipment, establishing laboratory safety procedures, and the like. There is no substitute for a good 2-day new faculty orientation explaining such things as the use of laboratory equipment, double-sided photocopying, word processing center operation, copyright laws, and so on.

In advanced electronics courses, instructors will sometimes spend many precious minutes laboriously copying large detailed schematics onto the chalkboard—when a simple overhead transparency projected directly on a board will show the schematic in vivid contrast. The instructor can then draw directly on the schematic using colored chalk, if necessary, to show the currents, voltages, and the like. If the drawing is particularly detailed, 8 1/2" by 11" copies can be distributed to the students, who can then draw on them, following the instructor at the board.

In the laboratory, the opportunities for demonstration are endless. Every piece of apparatus or measuring equipment that the student must master should be demonstrated by actual use by the instructor on a sample circuit. The demonstration method primarily promotes the development of reasoning skills (objective #7) on the part of the student. As learners are involved in the demonstration, they will normally generate new ideas; use previous knowledge in a new situation; recall ideas, facts, and information; and observe and ask questions about the demonstrator's performance.

Show-and-Tell Method

The show-and-tell, or sharing method, is by no means limited to the primary grades! (It is quite similar to the demonstration approach—but there are differences.) It has wide and varied applications at all levels. The essential ingredient is that the activity starts with a relevant experience and ends with the student sharing it. This approach involves a great deal more than merely presenting and discussing. It offers a meaningful, firsthand experience to the involved learners. Also, it often exposes students to a totally unique experience. Usually, students evince a strong attachment to the subject to be shared; this attachment may represent a high degree of expertness on their part. In short, this method involves students in sharing their knowledge with others. Such sharing may include the use of a wide variety of media, apparatus, or artifacts. This method, which provides a means for integrating manipulative activities with communication skills, may be part of a planned program whereby students discuss how and why they made a particular project, what was learned, and what special insights grew out of the activity.

Show and tell can be used with a minimum of instruction in technique. It may be used alone, as a reporting device, or with other approaches. Generally speaking, the following steps should be considered: discuss the necessary planning procedures and evaluative criteria, conduct the presentations within the established guidelines, and evaluate the results.

Instructor roles, in general, include facilitating the students' development of their own materials and stimulating them to achieve even deeper involvement in the topic. Student roles include planning, securing information, organizing presentations, clarifying items, answering questions, and assisting other students in similar presentations.

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It is rare in an electronics class of 20 to 30 students that at least 5 or 6 are not heavily involved in some phase of electronics as a hobby. From time to time, instructors can use this interest to enlist "guest lecturers" from the class itself. At the outset of the course, the instructor should ask for a list of interests and hobbies along with the usual personal data. Later, after choosing those hobbies that might relate to the course, the instructor can invite students to give informal presentations—complete with demonstrations—during one of the weekly lab hours assigned to the course. This technique, which represents a pleasant change of pace, usually is well received by the class.

Such an opportunity for the "guests" is an excellent means for developing communication skills in that they must be very careful in choosing appropriate words to convey accurate meanings when explaining their material, must speak fluently and effectively, and must answer questions efficiently and learn to rephrase statements for clarification.

ADDITIONAL INSTRUCTIONAL APPROACHES

Project Method

Sometimes the principle behind the project method is referred to as an "application integrator," that is, the project itself is a means of implementing—and applying—a number of related learnings. The purpose of the method, in brief, is to add more "reality" to the subject matter and to reinforce the learning that has taken place. A number of variations are possible: individual, small-group, large-group, and class or total school projects.

The procedures for carrying out this method vary. However, some of the general steps include determining goals and objectives to be attained (including affecting student behaviors), introducing the method, establishing criteria for selecting a project and the ground rules for conducting it, setting standards of performance, presenting the results either orally or in writing, and evaluating the project.

The main roles for the instructor are as follows: explaining the nature of the process, guiding the students, facilitating work with respect to resources and materials, challenging and questioning, monitoring activities, and evaluating the performance. Student roles vary depending on the size of the group involved. In large groups, students may be divided into committees, each with its own goals. A common technique for dividing the project work load of smaller groups is to assign each student individual responsibility. The student roles normally include conducting the project, interpreting the project to the instructor and the class, and formulating conclusions.

Most projects either are developed by the instructor to fit situational requirements or are found at the end of chapters in texts and workbooks. This simple fact does not imply that the project method is unimportant; it does, however, underscore the fact that project specifications often require the student to know some basic information. Therefore, putting project activities at the end of a textbook chapter or workbook is quite logical.

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It is feasible to devise projects that would enhance the development of every nontechnical skill since the project method has so many variations possible. Although all of the variations, from the individual project to the school project, can develop organization and management skills (objective #8), the projects designed for more than one student will best develop group problem-solving skills (objective #3). In group projects, students have to work together, cooperate, communicate, and make joint decisions if the project objectives are to be achieved.

For example, a project method of instruction, which has been very well received by the students in the Columbus (Ohio) Technical Institute's electronics department fabrication class, functions as described briefly here.

The instructor presents on the chalkboard the theory of operation of a regulated adjustable DC voltage supply. This theory is presented via derived formulas for such things as required filter capacitors, transformer turns ratio, and diode voltage ratings. At the end of the presentation, students are given an assignment sheet, which reads roughly as presented in figure 2.

Your assignment is to design and construct an O-24VDC power supply to fit in a 3" by 4" by 4" aluminum box. The design must incorporate the regulation scheme discussed in class. This entire project must satisfy the following department requirements:

1. You must submit a preliminary sketch of your design showing all component values and have backup calculations available to justify your choices.
2. When approved, your preliminary sketches must be made into a complete final drawing on vellum, using all the proper techniques learned in your electronic drafting class.
3. From this drawing, you must make a complete bill of material, which is to contain component size, type, current cost, and a local source. Be cost conscious.
4. A component layout drawing must be made as an aid to the assembler. The same procedures as in number two above must be followed.
5. An actual-size circuit board drawing must be made, with printed circuit paths shown; it must be suitable for photographing onto a photosensitive, copper-backed circuit board.
6. After etching the circuit board, you must mount your components, perform a complete electrical test, and report your measurements to your instructor.
7. Finally, you must mount your circuit in the chassis box provided. You may, if you desire, paint the box, add a small voltmeter, or individualize the final package in any manner you wish, consistent with safety requirements and good taste. (You have 5 weeks to finish this project.)

Figure 2. Student assignment sheet

Other projects, which one of the writers of this guide has assigned students during the past few years, have ranged from building, calibrating, and testing kit-form analog computers, to repairing and testing gift surplus electronics equipment and writing computer programs for solving textbook problems.

Activities such as those described here develop both planning skills (objective #5) and reasoning skills (objective #7). Note in the detailed example that students have several tasks to perform. They, therefore, will have to set priorities and keep track of the several possible activities needed to complete the task; they also will have to estimate the time required to finish the project and revise and update their plans periodically. In addition, students will develop reasoning skills by using previously learned knowledge in this new situation and by recalling ideas, facts, and information accurately. In addition, choosing components with cost in mind and making budgeting part of the requirements should assist in developing organizational and management skills (objective #8).

Problem-solving Method

Although the problem-solving method has unlimited applications in many vocational and technical areas, it is often used as a supporting activity with other approaches. Whether there is extensive use of this method depends on the instructor. If the instructor is inclined to provide most of the answers, there will be minimal use of this approach; if an instructor desires more decision making on the part of students, the method will be used more extensively. Although problem-solving processes are fairly complex, it is important to remember that often the processes by which one arrives at an answer may be more important than the answer itself.

Although a number of different problem-solving procedures exist, the following four-step process is commonly described: statement of the problem (to allow a wide range of possible solutions), brainstorming (again, to secure many possible solutions), judgment (close examination of all the ideas directed toward an optimum solution), and application (putting the proposed solution to use). Another description includes the following steps: identifying the problem, clarifying the dimensions, studying possible causes, developing possible solutions, testing appropriate solutions, and applying and evaluating the selected solution.

Using the problem-solving method, however, is not simply a matter of following preordained steps. The functioning of the method depends heavily on how the instructors and students see their respective roles. The method is at its best when the problems to be solved are identified by the students. Hence, the initial role for the instructor is to sensitize students to problems with which they can deal. The most important instructor roles include describing the nature of the strategy, presenting examples of problems other classes have addressed, assisting students in selecting problems with which they will be involved, interpreting procedures, providing advice and counsel, and evaluating performance. The students' roles relate to conducting the actual activity; hence, they assume a major function in all of the problem-solving activities noted.

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Bloom's familiar taxonomy of educational objectives defines *analysis* as the ability to take apart information, read between the lines, and distinguish between relevant and extraneous material or facts. Analysis is midway on the list of cognitive levels, which range from the least sophisticated form of cognition, knowledge, to the highest form, evaluation. Electronics students are taught in every course they take to analyze in order to solve problems. Thus, this approach certainly is not something new to electronics instructors. Literally every electronics textbook presents theory followed by example problems and then, normally, numerous homework problems.

While there does not appear to be any real need to elaborate on problem solving—perhaps because many electronics instructors may never have heard of Bloom's taxonomy—it would be wise to show briefly how analysis or problem solving leads naturally to, or implies, mastery of the other levels:

- **Knowledge**—This level of cognition involves simple recall and memorization of simple facts and principles. These facts and principles must be known to analyze electronic problems.

- **Comprehension**—This level of understanding requires the student to use facts and principles. One cannot solve problems unless one comprehends.

- **Analysis**—This entails the problem-solving approach.

- **Synthesis**—After becoming expert at analyzing circuits, it is a natural activity to try to design (that is synthesize) circuits for specific functions. Thus, the next higher level of cognition can be reached by a student well versed in the problem-solving approach.

- **Evaluation**—After learners have mastered both analysis and synthesis of design, they can begin to evaluate. This level of cognition also involves judging the work of others in order to improve on it and selecting the best of proposed alternative solutions to a problem. One who has mastered the cognitive level of evaluation can be said to be an expert on a particular subject. Therefore, a student who has progressed so far as to have mastered the level of evaluation termed cognition surely will have acquired problem-solving skills (objective #3) and reasoning skills (objective #7). It is a goal toward which all electronics instructors should strive.

Discovery Method

Students derive comprehension of various phenomena by direct involvement in a sequence of events, including observing, internalizing, formulating, and concluding. Discovery is the result of an individual's—or group's—involvement that permits a discovery to surface. In terms of instruction, the method uses different degrees of planning: a formal, structured experience with identified, expected outcomes and an informal, unstructured experience with unpredictable outcomes or results. Among the general goals of the method are a greater understanding of oneself, of the relevant elements (materials and processes) involved in a laboratory environment, and of the human environment in which one lives.

The procedure by which the discovery process is carried out varies, depending on the instructor and the nature of the activities. However, two basic forms can be identified: the informal and the formal approaches. The informal process has no precise structure. The discovery element is actually an additional phenomenon added to existing experiences. This process functions best when students are encouraged to develop an awareness of what happens when performing a task. Instructors stimulate such awareness by having students respond to questions regarding what they have observed or discovered. The formal process has the discovery of new information as a primary activity, that is, the desired information is identified, a plan is developed (and executed) for securing the needed information, observations are made, important factors are identified, and conclusions are drawn.

A number of specific activities can be identified. Instructors must try to encourage students to carry out the following functions: observing, discerning, relating, and generalizing. To facilitate the process, instructors can raise specific questions, thereby stimulating relationships between existing knowledge and the new elements in one's experience.

The instructor's primary role is to assist students in establishing a frame of mind for examining materials, processes, and events in terms of their qualities, causes, and effects. "Discovery sensitivity" may be developed by directing questions regarding the student's work, for example, "What did you observe when carrying out the task?" The following are areas in which instructors can assist students in the formal approach: identifying goals, planning activities, developing observational capabilities, organizing and analyzing information, and developing appropriate conclusions. In the informal process, student roles involve observing, identifying, organizing, generalizing, and concluding. In a more formal method, students take on similar roles but in a more direct manner, for example, establishing objectives, planning procedures, executing an action plan, observing outcomes, recording observations, synthesizing data, and drawing conclusions.

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A very successful method of conducting a laboratory experience is illustrated by the informal, unstructured discovery method of experimentation. A current trend in electronics laboratory courses is to depart from the usual "build circuit, record data, and tear-it-down" type of experiment. In its place, a new method has appeared—the "build circuit, observe operation, change parameters, and observe operation again" method of experimentation. The latter technique provides the learner with a much better picture of a circuit's operation.

In a complex circuit, so many "things" can change; to specify only a few for student observation is missing the total picture. A good way to simulate real-life situations is to ask the students to create their own changes. A typical discovery method laboratory assignment that develops a wealth of participative work environment skills is briefly outlined next:

Lab Assignment: Common Emitter-Transistor
Voltage Divider Bias

Your textbook has explained to you the reasons this form of bias is so often used. Choose any one of the authors' illustrative circuits and build it. After confirming each of the voltage calculations by actual measurement, change each of the components one by one by at least 50 percent and observe the circuit's new performance. Record all of your new data beside the old. Consider these changes. Would you have expected them? Why do you think they occurred? Would these changes have occurred to a lesser or greater degree in the other circuits you have studied? Report your findings using the standard department format.

Note how completing this assignment develops interpersonal skills (objective #1); students learn to work without the need for close supervision; they also learn to plan, conduct, and complete activities at their own initiative. This type of experiment, loosely structured as it is, also helps learners develop group process skills (objective #2): working in cooperation with a lab partner, coordinating activities with a lab partner, and demonstrating to lab partners how one believes the experiment should proceed. The experiment described helps develop problem-solving skills (objective #3) and—perhaps above all—requires the student to formulate a plan, thereby developing planning skills (objective #5). The price we pay for such unstructured investigation may be an occasional burned-out transistor, but this is a small price to pay for the learning that ensues.

Research and Experimentation

This approach is directed toward developing the student's capability for using the scientific approach in solving problems. When used appropriately, students actually identify and pursue their own problems. Often, the approach is expanded to include development; that is, a product is generated along with a research report. Some instructors suggest that each student be allowed to work on a different problem (except in some instances in which two or three individuals conduct joint research). They also suggest that a great deal of latitude be permitted in selecting a problem. The values of this method are numerous: the approach provides many opportunities for students to help one another, the approach has a high level of appeal for students with scientific and engineering interests, and most important, students learn to understand the language and concepts of the researcher. This approach is a good example of integrating a number of different methods discussed in this guide.

Several concerns need to be considered when implementing this approach, for example, the instructor's background with regard to research skills, the students' understanding and capabilities, and the acceptance of the approach by other instructors. The main procedures involve introducing the approach and actually conducting the research and experimentation.

The instructor's role—beyond developing students' understanding of the scientific approach—is one of facilitator, stimulator, resource person, consultant, advisor, and evaluator. Instructors play an important role in introducing the approach, as indicated in the following suggested activities: conducting a discussion on the importance of research, showing exhibits or slides of previous studies, and inviting researchers from industry to share their experiences. Some of the important student roles are developing background information prior to the research and experimentation (for example, library study); constructing apparatus and test models as needed; developing precise observations, measurement instruments, and recording devices; gathering accurate and unbiased data; analyzing the findings; and communicating the results.

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The 2-year associate degree electronics program has been designed to provide practical-minded, technically knowledgeable people who fit in industry midway between the skilled crafts person and the theoretical engineer and scientist. As such, the technician is trained principally in interpreting rather than initiating research activity. Interpretation involves considerable ability in reading and understanding technical literature as well as a good ability at hands-on activities. However, it normally does not require that intangible, almost instinctive, ability to formulate research activities that is characteristic of the engineer or scientist. Consequently, classroom time is much better spent in preparing the student for the experimentation phase rather than for research. Having the student identify a problem, research a solution, and present the results in a report is a good activity only if such problems are real-world technican problems. A technician is much more likely to be called on to *design* and test a logic circuit to monitor the temperature, pressure, and rotational speed of a new experimental automobile tire than to conceive and research a technique for predicting incidents of failures in rubber and cord passenger tires. The design activities are the follow-up after the concept has been researched. These activities are often assigned to technicians, thereby releasing the engineer or scientist for further analysis, synthesis, and evaluation-type activities.

Assigning design problems is appropriate in the second year of a 2-year degree program and throughout the third or fourth years of the bachelor of electronics technology (BET) program. Such design assignments develop interpersonal skills (objective #1) in that they train students to work without the need for close supervision; to plan, conduct, and complete activities at their own initiative; and to work effectively when time pressure is a critical factor for success.

Problem-solving skills (objective #3) are also developed since the learner must identify the problem when given the facts, ask appropriate questions, identify important information needed to solve the problem, generate alternate solutions, and select the best course of action. If the design assignment takes several weeks of a school term, it can also develop planning skills (objective #5) by requiring the designer to set goals and priorities, outline step-by-step processes, revise and update activities, and estimate time requirements. Lastly, design activity develops reasoning skills (objective #7) in that students will generate new ideas, use prior knowledge, and recall ideas.

Individualized Instruction and Performance-based Instruction

Although individualized instruction has been defined in many ways, the process normally includes specification of objectives in terms of observable competencies, a detailed diagnosis of learner characteristics, provision of alternative instructional procedures, and continuous assessment of learner progress. Students are provided the opportunity to progress at a pace suited to their abilities and styles. Since the approach allows students to learn at a variable pace, entrance into and exit from the program is often flexible.

Procedures vary according to the differing types of individualized instruction. For example, the following types can be identified: *individually diagnosed and prescribed* (the objectives are determined by the instructor who also selects the media to be used in learning); *self-directed instruction* (the objectives are determined by the instructor, but students select the medium and method of learning); *personalized* (students determine the objectives with the assistance of the instructor); and *independent study* 4(students determine the objectives as well as the medium and method of instruction). In addition, performance-based instruction is also relevant and will be discussed in more detail.

In the individualized approach, the instructor becomes the learning manager. This role entails diagnosing learning problems, suggesting alternative activities, serving as a consultant, and performing evaluation activities. Recognizing the difference between students, the instructor must deal with each person separately. It is also important that students understand their roles, since they too become active participants in the process. Responsibilities—such as assuming responsibility for maintaining a proper learning environment—must be assumed by each learner. Students must also learn to manage their time and participate in the decision-making process by selecting appropriate instructional methods that will enable them to accomplish their objectives.

Performance-based instruction is a term heard more and more these days. "Several performance-based resources are available."* The following is a brief overview. The approach has five essential elements: (1) competencies to be achieved are carefully identified, verified, and made public in advance; (2) criteria to be used in assessing achievement and the conditions under which achievement will be assessed are explicitly stated and made public in advance; (3) the instructional program provides for the individual development and evaluation of each of the competencies specified; (4) assessment of competency takes the students' knowledge and attitudes into account but requires actual performance of the competency as the primary source of evidence; and (5) progress through the instructional program is at the student's own rate when they demonstrate the attainment of specified competencies.

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*For more details, see R. E. Norton, *CBE: A Humanistic and Realistic Approach to Technical and Occupational Education for the '80s* (Columbus: The National Center for Research in Vocational Education, The Ohio State University, n.d.). See also the Performance-based Teacher Education (PBTE) module, K-1, *Prepare Yourself to Implement Competency-based Education* (Athens, GA: American Association for Vocational Instructional Materials, 1985).

The desirable characteristics of performance-based programs are as follows: instruction is individualized as much as possible, rather than group paced; learning experiences are guided by frequent feedback; emphasis is on helping the student achieve program exit requirements; instruction is individually paced rather than time based; instruction, to a considerable extent, is field centered and based on realistic work situations; and instruction is often modularized and uses materials with both required and optional learning activities to provide for different learning styles. More time is needed for the instructor to develop materials, work with individuals and small groups, and assess students; less time is needed for lesson planning, lecturing, and large-group discussion.

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With individualized instruction, students are allowed to progress at a pace compatible with their learning abilities and styles. This technique results in students' completing various activities at different times. In the rigid time frame of the typical 2-year postsecondary electronics program, little, if any, flexibility of this type is found. Yet—on the outside at least—one company (the Heath Company) has fashioned a successful program of electronics instruction directed at working technicians and engineers who desire to update their knowledge on a part-time basis in the comfort of their own homes. This self-paced instruction seems to work well in such a postdegree environment.

On several occasions, one of the writers of this guide—while working toward a master's degree in college teaching—asked several fellow engineers-turned-teachers why this form of instruction could not be used within the 2-year degree program as successfully as it is on the outside. The answers were almost always the same:

> "Individualized and self-paced instruction? How can I give individual attention to 60 students in one class?"
>
> "It sounds like you are saying that given enough time and the proper techniques, you could turn any sow's ear into a silk purse."
>
> "Self-paced instruction works with technicians on the job because they are the end product of a severe weeding-out process called 'working for the associate degree in electronics.' They are bright and can learn from any instructional method."

What it would take to stimulate the majority of the electronics instructors to change from the traditional instructional approaches is uncertain. The range of explanations is extensive: "There is a lack of instructional materials available," "There is no time to develop materials on one's own," "I do not buy the concept," "I am not paid enough to innovate," and so on.

Determined to introduce some type of individualized instruction into his own program, one of the writers of this guide wrote a series of self-paced learning modules in book form, *Programming the Hewlett Packard 11-C Programable Pocket Scientific Calculator*. It was designed to give the student proficiency with a school-adopted pocket computer. Because of the very tight 2-year schedule, the instructors found it impossible to teach a course in computer programming along with the required electronics subject matter. It was decided, therefore, to make this manual available for the beginning students to "dip into" at their own pace as time permitted. The results were better than expected. The students reported that they were learning to do things with the computer. The instructors were relieved of the task of teaching computer programming—and the graduate school accepted the series as a master's thesis. All in all, the project was a success.

It seems to be the opinion of many textbook writers and electronics instructors that the electronics program at the associate degree level is simply too demanding to expect students to pace themselves through it the way they might in a course such as appliance repair. Many instructors seem to feel that it does poor students a disservice to let them struggle through a program at a "slow learner" pace. When such slow learners have finally, after 3 or 4 years, managed to complete the degree requirements, they would probably have a hard time getting hired, since the world of electronics operates on a "fast track." Employers would feel—and rightly so—that a slow learner in school would function the same way on the job.

Based on experiences with self-paced instruction, the writers recommend that the approach be introduced to the student, not as a means of getting an associate degree in electronics, but as an auxiliary means for the employed electrician to learn about some phase of electronics, perhaps as an extra-credit project. Then, after acquiring the degree, students will be familiar with programs such as those of the Heath Company or of an employer's own in-plant educational programs for upgrading skills.

In summary, there is no doubt that individualized instruction develops a learner's ability to work without the need for close supervision; to plan, conduct, and complete activities on one's own; to determine step-by-step processes that accomplish specific tasks; to gather information from books and manuals; to explain main ideas in another's written communication; and to recall ideas, facts, and information. Using this process, there is little question that the following objective will be achieved: acquisition of interpersonal skills, planning skills, communication skills, and reasoning skills (objectives #I, 5, 6, and 7, respectively).

Contract Method

In the contract method, the central teaching and learning principle is an agreement between students and the instructor. Although the contract itself may specify a particular form that the contract fulfillment may take, the degree of specificity is worked out between the parties involved. This method, as noted, is an agreed-upon arrangement between the students and instructor with respect to the proposed accomplishments of the students and the reward system established for these accomplishments. It may be used either with a single student, a group of students, or with the entire class. The main purpose is to establish a direct link between the students and the instructional programs—in terms of what students study and how the studies are carried out. The contract method is suited to a wide range of learner interests and abilities.

The following procedures are most important: providing background information about the nature of the method itself; planning the contract, including the extent to which students agree to perform, the time limits, and the expected rewards; negotiating the contract so that each party knows what is expected; and modifying the contract in situations where changes need to be made, for example, scope of coverage, time requirements, performance standards, and rewards. The main activities relate directly to the contracting aspects of the experience and are used to fulfill the commitments of the contract. For example, the former category includes planning, negotiating, contracting, and modifying; the latter category includes an endless variety of activities in fulfilling the contract: reporting, designing, constructing, demonstrating, comparing, identifying, and so on.

In some respects, instructor and student roles are similar. The instructor is normally the major planner (setting goals and purposes, providing forms and contract guidelines, establishing evaluation and reward procedures), negotiator, contractor, facilitator, and evaluator. Students, similarly, fulfill the roles of planner (what is to be done and how it is to be accomplished), negotiator, contractor (making a commitment to perform), and modifier. These roles are similar to those that students will be required to perform many times throughout their lifetime.

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Contracts—whether between an industry and its parts suppliers, janitorial services, or union employees—are part of the real world of work. Today, with the emphasis on joint participation of labor and management in decision making, the "I can do this—you can do that" job description has become the rule rather than the exception in many work environments. The contract method of instruction, therefore, could assist in preparing technicians for the real world. Here are four brief examples of how to infuse QWL objectives into instruction.

An electronics instructor gives the students several options for fulfilling the school requirements. To earn the ultimate grade (an "A") in this class, they must do the following: score at least two standard deviations above the average on four out of five quizzes; submit four out of five research papers assigned with evidence of superior quality in terms of accuracy of content and grammar; have no more than two unexcused absences throughout the quarter; and show consistent willingness to participate in class discussions. The "B's," "C's," and so on are assigned accordingly, with rewards based on how close to the ultimate score these accomplishments come.

A case in which a graduating student had somehow not taken an elementary laboratory requirement was settled to everyone's satisfaction by the student's contracting with the instructor on a special basis to assemble and test several pieces of laboratory gear that came in kit form. Such assembly and calibration actually required more skill than would have been needed in the "skipped course"! The grade assigned was to be based on the contract's stipulations concerning the proper functioning of the finished product, the neatness of construction, and the speed with which the project was finished. It was estimated that two 3-hour lab periods would be needed per item and that standard assembly and soldering guidelines would be invoked to determine this portion of the grade.

An evening school instructor who gave weekly quizzes contracted with a part-time student who was going out of town on regular company business. In lieu of examinations, the student was given a grade based on the number of successful extra homework problems that had been completed. The assignment involved approximately four times as much work as the examinations would have. Both parties agreed that this compensated for the extra time allowed.

Most schools require the instructor on the first day of the course to spell out such concerns as grading policy, attendance policy, and the like. All of these constitute a contract when put into writing. In truth, there are many situations in which a technology student could be exposed to contracts.

In short, the contract method of instruction develops interpersonal skills (objective #1) by making students responsible for their own judgments and actions and by requiring completion of the contracted activities at their own initiative. The method also develops decision-making skills (objective #4) since, in negotiating a contract, students must make a very important decision at the start, namely, whether to accept the contract. Lastly, planning skills (objective #5) are also developed when the student, with the contract continually in mind, must set priorities, list possible activities needed to complete the contract, estimate the time required to accomplish the contracted task, and periodically update the activities in order to fulfill the contract.

Peer Teaching and Peer Tutoring

Using students as teachers and tutors is becoming more common—from the elementary school to the graduate school. The growing popularity of this approach appears to be based on the increased acceptance of the view that students are more than passive receivers of instruction. Peer teaching and tutoring and using students as teachers are accepted ways of providing opportunities for more advanced students to become involved with their learning. Peer tutoring, particularly, is an acknowledged means of promoting individualization, since it allows learners to spend more time in one-on-one situations. Both tutors and learners have an opportunity to learn in a noncompetitive atmosphere. Although learning from one's peers should be an ongoing process, organized peer tutoring has not been regularly included as a planned classroom activity. Nevertheless, this method is usable in a variety of situations, limited only by one's imagination.

When establishing these types of programs, instructors need to consider the following: specifying and assessing outcomes, specifying procedures and materials, training student assistants, and monitoring their activities. Selecting tutors and learners, matching "pairs," and determining the number of student assistants are also essential activities.

It is important that students who participate in peer tutoring be given sufficient orientation. Instructors must be certain that the assistants are knowledgeable about the concepts or facts they will be presenting. A good training technique to use is role playing. During these sessions, student assistants should be asked to focus on finding alternative ways of explaining concepts and encouraging learners to complete their assignments. They should also be taught how to ask questions and give positive reinforcement. Adhering to a lesson plan and providing a positive role model should also be stressed. Another training task is to teach tutors to give appropriate corrective feedback, that is, to acknowledge correct answers and give the learner a chance to provide correct answers.

Instructors need to make certain that student assistants have the necessary resource materials. They also need to evaluate the assistants and aid in self-evaluation. Training and monitoring cannot be stressed excessively. The former should prepare the assistants for exactly what they will do when they sit down to work with learners. Instructors must also provide assistants with a well-defined set of assignments and demonstrations on how to use the instructional materials. Monitoring to observe how well the assistants are handling the situation should occur regularly. The assistants, in turn, need to plan their work carefully and take their responsibilities seriously.

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The ability to stand in front of a group, ask appropriate questions, and listen well are characteristics of a good teacher. These communication skills are readily developed in the classroom, as any experienced instructor can attest. What more convenient way is there for instructors to help students with leadership qualities to prepare for leadership positions than to let them take the role of classroom managers occasionally? On several occasions, as a new teacher of electronics, one of the writers of this guide had the opportunity to let talented students explain some "pet" electronics project to the class. This proved to be of such interest to the class that after a few years of teaching, he began using the technique regularly. Early in the quarter, he asks the class (in a casual manner) if they have studied the material. The weaker or more timid usually do not

respond. However, the brighter and more aggressive usually answer affirmatively. They are not intimidated by the possibility of the next statement: "Good, now let us see how well you have studied." This technique usually results in the four or five top students coming forward. It is then proposed that if students really know a subject, they could explain it to others and make them understand. As motivation and reward, this writer is willing from time to time to let a 15- or 20-minute presentation of some aspect of theory replace a scheduled weekly exam. The two or three students who volunteer are invited to a brief conference, at which time this writer explains the topics, defines any time constraints, and outlines the steps a good instructor must take when presenting material. Then, about every 2 weeks throughout the quarter, a half hour or so is devoted to letting the students teach their prepared topic.

This technique gives students invaluable practice in developing planning skills (objective #5), communication skills (objective #6), and various organization and management skills (objective #8) in a way no amount of passive listening could.

Seminars

Although seminars are normally associated with graduate or professional studies, many instructors indicate that they can also be used in undergraduate and technical school settings, often in conjunction with research and experimentation, lectures, projects, and conferences. Basically, a seminar is an organized gathering of students brought together to discuss, challenge, or debate one or more topics presented either by one or more members of the group or by invited consultants. Following the presentation, opportunity exists for clarifying and sharpening the issues. Seminars serve important content functions: introducing new elements of content, applying theory or knowledge, and clarifying selected elements of the content. They also serve such important behavioral functions as challenging the validity of materials presented and formulating one or more positions regarding one's acceptance or rejection of the information.

Although seminars take many different forms, in general, the procedures include developing an agenda, selecting a seminar leader, discussing the agenda and the ground rules, and supplementing the presentations with appropriate audiovisual materials. The nature of the seminar results in the frequent challenging, evaluation, reinforcement, and perhaps even changing of ideas.

Instructors' roles vary, depending on the sophistication of the students. The initial seminar, for example, might find the instructor devoting time to clarifying roles, explaining what the seminar might accomplish, and providing guidance. As the students become more involved with the approach, they often take on a greater role in planning, assisting, and evaluating. Students should be encouraged to present any problems they are facing—whether they relate to apparatus, procedures, or techniques. They also should be encouraged to assist other students and help with the solution of problems. Hence, this activity could provide an exceptional opportunity for students to work together cooperatively.

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Although the typical 2-year electronics program is sometimes overcrowded with technical matter—thereby necessitating fast-paced lectures as the most efficient means of presenting the material—the 3- or 4-year bachelor's program in engineering technology, in particular, has room for a number of innovative strategies. The seminar method clearly belongs in such programs. According to Hoover,* the method appears to be designed for those courses in which an organized body of content does not exist. This fact alone would almost rule it out in a normal 2-year electronics program in which everything is explicitly laid out from the first quarter to the last.

The advantages of the seminar method are as follows:

- It is a self-directed method that places responsibility on the student as the presenter of facts. This develops both interpersonal skills (objective #I) and group process skills (objective #2).
- It involves roundtable discussions and, hence, develops oral communication skills (objective #6).

*In *College Teaching Today* (Boston: Allyn and Bacon, 1980).

- Although they basically do not serve as decision makers, seminar members must, early in the activity, identify and clarify problems for later in-depth exploration, thus developing both problem-solving skills (objective #3) and decision-making skills (objective #4).

In short, seminars work well in a 4-year bachelor of electronics technology program in which small groups of students interested in some area of electronics with no organized body of content get together to try to organize these facts.

Instructional Worksheet Method

The term *instructional worksheets* applies to a number of related items: information sheets, job sheets, operation sheets, and assignment sheets. Since such worksheets normally are developed by the instructor or a group of instructors, the formats vary. However, information sheets generally consist of one or more pages of information related to a particular topic; assignment sheets are printed and graphic presentations setting up work to be accomplished; operation sheets contain steps, procedures, equipment, and materials needed to perform a function; job sheets contain printed and graphic terms intended to aid an individual in carrying out a job or project. Instructional worksheets can be valuable in that they provide students with background materials that support discussions and demonstrations, assist students in independent studies, supplement the normal instructional program, and aid students in preparing for examinations.

When preparing instructional worksheets, instructors need to be alert to the following problem areas: information beyond the student's level of understanding, too much detail, a reading level that is either too high or too low, incomplete illustrations, the inclusion of too many topics, inaccuracies appearing in the material, unappealing format, and out-of-date content. All of these considerations should be attended to when developing worksheets.

The problems listed here should serve as guidelines for both preparing and using such materials. For example, instructors need to make certain that the information is understandable, readable, accurate, and up-to-date. Moreover, they should use these materials in moderation. Worksheets should be considered as "desserts" rather than the "main course." As such, these often are valuable when used for homework assignments, supplementary learning, and enrichment activities.

The following problems also should be taken into consideration when using these materials: instructors sometimes tend to make excessive use of these sheets; they sometimes dismiss students' inquiries by referring them to the sheets for answers; and they sometimes structure the program around providing worksheets without considering the students' needs. Instructors and students alike need to avoid using worksheets as a crutch. Above all, these materials should never be used for busywork.

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Occasionally, a course is offered for which no suitable text exists. The early microprocessor programming courses and the very early, then state-of-the-art, electronic devices courses that offered field effect transistors for the first time are examples. In such cases, instructional worksheets were often used. Even when a text is available, additional material not found in the text must sometimes be presented. Again, instructional worksheets are appropriate. Consider the following example from a course in electronic devices.

In the middle to late 1960s, the field effect transistor (FET) and its applications began to appear in the technical literature. Since engineers were beginning to design with this device, it was reasonable to assume that technicians would be familar with it. The problem was that textbooks at the 2-year level hardly presented this device—except very briefly, if at all. To present the FET, instructors in the electronics program at the Columbus Technical Institute (in Ohio) prepared a

three-page summary of the FET's theory and applications. This summary was given to the students at the appropriate place in the course. Along with these information sheets, the instructors presented an assignment sheet of circuit analysis problems and a laboratory experiment sheet containing a list of equipment and the general procedure to be followed to test the device in the lab. This trio was considered to be a sufficient introduction to the new device to enable the graduating technician to work with it in the field. Of course, the instructor explained it in the classroom and assisted with the experiment. Surprisingly, students seemed to find this method of study preferable to that of the textbook approach. Perhaps it was the novelty of the method or the fact that the text, with its extensive information, tended to overwhelm the reader.

This approach is not widely used now because, for the most part, texts have managed to keep current. However, it has been tried and proven effective as an introduction to the occasional new device or circuit.

The instructional worksheet method develops interpersonal skills (objective #1) in that it requires learners to study and work without close supervision and to plan, conduct, and complete activities on their own. It also develops problem-solving skills (objective #3) by requiring a completed assignment sheet. By requiring a laboratory performance based on general procedures rather than a spelled out list of detailed steps, the method also develops planning skills (objective #5) and reasoning skills (objective #7) since students have to create or plan their own activities based on prior experiences.

Case-Study Method

The case-study method consists of students' examining all dimensions of a real—or theoretical—problem and projecting possible solutions based on data collection. Case-study problems of actual experiences are an effective learning strategy. Students seem to work harder on analyzing real situations. The purposes of this approach are to assist students in recognizing that a single problem may have many potential solutions and to enable students to develop their analytical capabilities. Case studies can be used to illustrate a point, get an entire group thinking about a specific problem, or encourage discussion.

Case studies can be used with individual students, small groups, or an entire class. Regardless of the group size, the procedure remains the same: problems should be isolated and clearly defined, an analysis should be made of the factors that contribute to the problem, relevant information should be compiled, alternative solutions should be determined and examined, and the best solution should be proposed and evaluated for its effectiveness in solving the problem.

The best alternative a group can come up with in a particular case would be, of course, a correct solution; however, case-study problems often have no right or wrong answer. Care should be taken, therefore, to ensure that the setting provides for optimal student discussion and group interaction. Adequate time to complete the case study should be allotted if the best solution is desired as the outcome. Students need time to consider each of the alternatives. Since case-study problems vary in their length and involvement, time requirements will differ. Generally, case-study activities take place in lab areas, although sometimes the pursuit of a solution may take students beyond the school setting. Students have a great deal of opportunity for involvement since—to a large extent—they engage in self-directed activities and are provided with considerable opportunities to apply ingenuity and resourcefulness. In short, the major activities include identifying problems, making decisions, weighing the relative merits of proposed or projected solutions, and applying proposed solutions whenever appropriate.

The instructor's main roles are as follows: providing background information and explanations, clarifying the problems, maintaining direction and focus on important issues, providing guidance in decision making and problem solving, and assessing the appropriateness of the solutions. Student roles include assisting in developing the background of the problem, suggesting possible solutions or courses of action, deciding on actions to be taken, applying the proposed actions to the problem, and evaluating the results of the actions.

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Case-study problems, in general, provide an excellent means of infusing group problem-solving skills (objective #3). Since many case studies are used in a small-group setting, such skills as working as a member of a team, showing empathy, and learning to resolve a problem can be practiced. Depending on the size of the group, each student's problem-solving and decision-making skills (objectives #3 and #4) can be developed to some extent. (Large groups obviously provide less chance for interaction.) Oral communication skills (objective #6) can also be practiced with the case-study approach, especially if group reports and class discussions of solutions are used. Not only do case studies provide an excellent means of generating class discussion, they can also be used to determine what students have learned from a particular unit.

The case study can be used to "stir up" discussion and debate on questions that have several possible answers and on problems with more than one possible solution. This open-ended controversy often leads to the best or most probable answers and solutions. For example, some of the most productive electronic circuit design, analysis, and troubleshooting in the real world is accomplished when small groups of people get together, discuss, probe, and analyze until a clear solution to the problem emerges. The case-study approach can serve to trigger this type of debate in the classroom.

A typical case study is a "story" of a realistic problem or situation. Since a case analysis is a search for the common denominators to these problems, this form of study is extremely valuable for training technicians in the art of troubleshooting. Let us substitute the phrase "case of trouble" for "case analysis." By analyzing several "cases of trouble," the technician will realize (eventually) that every case studied is somehow related to all other cases.

A typical result of much experience in case analysis is that students can often see their own future problems in a detached, objective manner. In terms of troubleshooting, this means technicians can stand back and analyze their own future "cases of trouble" and, as if they were advising the technician in the cases studied, give advice to themselves.

Example Case

Technician Thompson, who works for the customer service department of a large electronic game manufacturer, routinely inspects several returns each day with similar symptoms. The light-emitting diode (LED) display of a certain line of chess computers slowly pulsates in brightness when it should be a steady bright light. Further testing with a factory standard chess computer leads the technician to suspect a bad power supply rather than the computer itself. However, upon measuring the open circuit voltage of each returned supply, our technician finds them up to "specs" even though they do not function properly when connected to the computer. This would indicate a bad computer. These contradictory results have the technician completely baffled.

Question: What would you advise the technician to do?

Possible Answer: All power supplies function properly only under full load. Check the DC output voltage and ripple voltage under simulated load conditions. This should be done anytime a power supply is suspect. Possible problems could be a bad filter capacitor or a diode with a large reverse leakage current.

By analyzing this case, the class will most probably be able to solve similar problems in the future—having a feeling of déjà vu!

This brief illustration should help students develop problem-solving skills (objective #3) in that it gives practice in identifying the existence of a problem—given specific facts, enumerating the possible causes of a problem, and generating possible alternate solutions to the problem. Group process skills (objective #2) should also be developed in that the students must join in and draw others into task-focused conversations—as well as observe the instructor leading the group in resolving disputes and in achieving consensus among the group members. Members of the group should also develop communication skills (objective #6) and reasoning skills (objective #7) by the very nature of this method.

Conferences

The instructional conference is one of the most frequently used teaching techniques, particularly in business and industry. Although the term is used to describe a number of activities, two common denominators exist: a problem or topic of mutual interest exists *and* brings pertinent knowledge and understanding to the session (or sessions). The conference is basically a meeting of two or more persons to explore, delineate, or interpret topics relating to the skills and expertise of the conferees. In addition to being an instructional tool, the conference is also a problem-solving and communications device. It is important to note that the conference has an explicit purpose and that it draws on participants who have pertinent information or insights to share. The conferees should possess differing talents and understandings so that a maximum of input can be gained on the topic being considered.

Although the conference has few precise dictates regarding "what," "how," and "when," two important points should be stressed: the conference should have clear goals and all subsequent actions should move the participants toward attaining these goals. Several general suggestions are in order for preparing a conference: planning is essential; the appropriate participants (as well as conference leader) should be identified; the topic should be understood by all; and an agenda should be drawn up. In terms of conducting the conference, these procedures should be considered: present information and instructions related to the topics, make assessments of progress along the way, summarize the results, and draw conclusions. In short, the main activities are these: setting goals, allowing sufficient time for conferees to present their information or insights, incorporating visual presentations as needed, and recording the primary points.

Both instructors and students have several roles. The conference leader (either instructor or a student) attempts to keep the session focused on the intended goals, encourages input from all the participants, discerns important points, presents intermediate and final summaries, and outlines a future course of action. The conferees assist in preparing materials, analyzing issues, formulating conclusions, and planning subsequent actions. Often outside consultants are called upon to present information or advise on related issues. The instructor's role takes on varying forms depending on the purpose of the conference, the nature of the students, and the nature of the topic. Often, instructors observe, record, and evaluate both individual student performance and the value of the conference.

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The conference—particularly in industry—is a most important problem-solving activity. Typically, a group of engineers and technicians involved on a project get together over coffee and outline some form of attack on a technical problem. The problems tend normally to be of a broad nature. Thus, at the conference level, one would more likely be involved with the problem of interfacing a telephone PBX to the outside world rather than with solving the problem of the resistor burnout in trunk module X. For this reason, conference techniques appear more appropriate at an advanced level after the student has begun studying systems.

Example Case

A group of five second-year students interested in satellite communication systems meet with the instructor to discuss an extra-credit project involving the design of a simple and inexpensive

receiver system for providing educational broadcasts to remote Alaskan Eskimo villages. The instructor sets a time frame, suggests a maximum dollar cost, and—after establishing intended goals—assigns various parts of the project to the individual students. At subsequent meetings, the students make presentations, suggest revisions, and so on.

In short, this procedure—a variation of a small-group conference—can assist in developing group process skills (objective #2) in that it gives everyone the chance to participate as a team member, teaches students to cooperate with other members of the conference, and requires members to coordinate their activities with others. This method also assists in developing interpersonal skills (objective #1) in that the member must be on time for meetings and activities, sees things from someone else's view, and initiates task-focused conversations with others. Lastly, the technique assists in developing problem-solving, communication, and reasoning skills (objectives #3, 6, and 7, respectively) as is implied by the very nature of the activity.

Business Enterprise and Entrepreneur Approach

The business enterprise and entrepreneurship approach is a form of instructional organization that involves integrating various approaches. The method assumes the dimensions of a business enterprise that starts with forming a company, selling stock, developing a management organization, selecting and designing a product, surveying the market, producing, packaging, marketing, redeeming stock, and dissolving the company. Its greatest value is that the method relates to real situations found in business. Many opportunities exist to develop leadership, responsibility, social interaction, cooperation, and communication skills.

The following topics should be taken into consideration: the instructor's capability, the student's background and experience, the institution's philosophy and regulations, and the classroom's physical adaptability. The instructor's capability relates to such issues as handling the flexibility that is needed in this somewhat open-ended approach. The student's background must be considered in terms of interest and sophistication. The overall school philosophy is also a factor, particularly regarding the degree of freedom in student decision making and leadership that is commonly needed in such a program.

The instructor's role includes introducing this activity and, particularly, assessing the students' readiness. To accomplish this, instructors normally present films on the approach, conduct field trips to show students the approach in action, act up visits to industrial plants having the essential components that need to be understood, and invite guest speakers from business and industry. The approach also involves a great deal of student control, leadership, and responsibility.

Some important questions that the instructor must answer early in the process are as follows: Should the entire class participate? Does the program (the business) operate during or outside of class hours? What should the relationship be to other businesses in the community that offer similar products or services?

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The actual number of electronics technicians who have gone on to become owners of companies, designers, producers, and sellers of a product is uncertain. However, it is assumed that the majority continue to make a career in troubleshooting, testing, modifying, and repairing products. Nevertheless, in any class of students, there are always those who stand out as being capable of entrepreneurship. The instructor should easily recognize these individuals and encourage them to take electives in business, retailing, or management in order to nurture their talents. Such courses readily develop participative work environment skills since they often deal with people working together to accomplish a specific task. They explicitly develop interpersonal skills, communication skills, and above all, organizational and management skills (objectives #1, 6, and 8, respectively).

One of the writers of this guide has used this indirect form of instruction in the past to steer potential leaders into management positions. On several occasions, these students have returned for a visit after 5 or 6 years in industry and expressed their gratitude for being directed to elective courses that clearly led to their advancement in management positions.

Audiovisual Approaches

Audiovisual (AV) instructional materials involve both the hearing and sight of the student and are effective tools to use in generating interest in a subject, in illustrating situations that are difficult to create in the classroom, and in helping provide additional information about a topic. Audiovisuals come in all shapes and sizes, but the most common ones are films, filmstrips, slide presentations, videotapes, and transparencies. These materials often help supplement a subject area and are readily infused into any curriculum. Many AV materials are not designed to stand on their own; often they can supplement some other type of instructional material—a textbook or workbook—or they may be used in group discussion to achieve their intended purpose.

Because most AV materials—especially films and filmstrips—are most effective when shown in their entirety in one sitting, the time factor is somewhat rigid for this strategy. Generally speaking, the major instructor roles are to operate the equipment and conduct appropriate discussion and follow-up activities; students generally practice their listening and note-taking skills until the conclusion of the presentation.

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Since this strategy requires the hearing and sight of the student in order to be effective, the use of AV materials will develop listening, one of the many communication skills (objective #6). Some AV aids, especially films and filmstrips, are written in such a way as to encourage reasoning and logical thinking (objective #7) and may help students develop their own opinions about a topic. Also, not only do audiovisuals help develop listening skills, they almost always make the subject more interesting by providing variety to classroom experiences. Undoubtedly, the effective use of AV materials contributes directly to the accomplishments of many teaching and learning objectives.

EXPERIENTIAL INSTRUCTIONAL APPROACHES

Cooperative Education

One experiential approach that deserves special mention is cooperative education. Through an arrangement with business or industry, students are provided experiences that enable them to develop occupational skills and knowledge. Although various types of programs have been developed, the following have direct implication for vocational and technical education: (1) cooperative vocational education—an instructional plan combining part-time employment and on-the-job instruction with learning experiences gained through vocationally oriented school instruction; (2) cooperative work training—experiences that enable students to develop into responsible workers (although workstations may not be in the occupation the student hopes to enter and need not be related to occupational courses being taken); and (3) work-study—a financial assistance program providing students with part-time employment.

The initial step is to find workstations that can provide the necessary job experiences. In choosing the appropriate station, several employers should be visited before making a selection. The following criteria should be considered: employers should understand the purposes of the program; a reasonable probability of continuous employment should exist; employers should have proper facilities to provide appropriate learning opportunities; students should receive the same employment status as other part-time employees (wages, insurance, and the like); and employers should provide adequate supervision. In addition, the job should provide useful training, not just routine activities; the workstation should be conveniently located; tasks should be within the range of student abilities; employers should have excellent relations with labor; and hiring, promotion, and dismissal practices should be consistent with program goals. In addition, a written training agreement, which lists experiences and skills that will be provided to the student on the job, is advisable. It should contain the following items: the number of hours the student is to spend on the job and the responsibilities of the student, employer, and educational institution. Additionally, everyone involved must understand and work within the framework of relevant local, State, and Federal labor regulations. Lastly, a major activity is supervision: follow-up calls, regular visits, and detailed record keeping must be conducted to assist students in making needed work adjustments and to evaluate the effectiveness of each student's experience.

The instructor-coordinator is a learning manager with responsibilities in the school as well as in the community. Primary roles include placing students at workstations, assisting students in adjusting to work environments, correlating classroom instruction with on-the-job training, assisting students in making personal adjustments, directing vocational youth organizations (if applicable), administering activities, and maintaining good public relations. Student roles include attending work and classes regularly, performing both work and classroom assignments efficiently,

conforming to regulations, and consulting with the instructor-coordinator about any difficulties they might be encountering.

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Cooperative programs for students in electronics technology have been available for several years. However, they represent the exception rather than the norm. These programs appear to be somewhat regional—with the heaviest concentration in schools near companies employing large numbers of their technical graduates. A major problem, however, is that most degree programs are planned for the 2-year, full-time, traditional student. When a company expresses interest in hiring a 2-year student for a half-day co-op program, they often base it on the conception that the student will be able to work for them full-time in 4 years. This, however, is usually not the case. Because the scheduling of classes is designed for the full-time student, any deviation from this schedule by the cooperative student may postpone graduation for 6 or 8 years. A particular course usually cannot be offered during a time slot convenient to the working student 4 quarters per year. In spite of this problem, a company in need of technical help will occasionally attempt to accommodate the students and the school by assigning flexible work hours so that students can attend school when the courses are available.

Columbus Technical Institute in Ohio, for example, currently is involved with the Digital Equipment Corporation in a small cooperative program. However, since the majority of companies are hiring few students this way, schools sometimes see no need to change the scheduling to accommodate the limited number (3 or 4 percent) of the total student population involved. Cooperative programs, hence, need a great deal of "supportive implementation" in the typical 2-year program. (Another cooperative education approach at the postsecondary level is often designed as full-time employment during alternating school terms.)

Nonetheless, cooperative programs—where successfully implemented—could develop interpersonal skills (objective #1) and group process skills (objective #2). By its very nature, the program requires students to enter into the world of work where such skills are used every day. The other skill developments would depend on the nature of the cooperative position. That is, if the program were based on a participative work environment, all other skills identified with such an environment would be developed.

On-the-Job and Other On-site Approaches

In addition to cooperative education, considerable use has been made of on-site approaches through such programs as on-the-job training, internships, apprenticeships, and the like. The variety of working and learning experiences in the community are extensive; for example, field trips, interviews, and job shadowing are examples of short-term efforts. Another form of linkage involves the community serving as a major source of information, with the school functioning as a locus for managing the use of away-from-school instructional activities (paid employment, regularly scheduled visitations, and extended field experiences). The main focus in these approaches is that the major source of information is shifted from the formal school structure to the community work site.

Although community and school involvement involves a number of procedures, communication is the first step. This step is aimed at bringing the two groups together in a working relationship. Developing an "inventory" is also an important early step, that is, an extensive list of locations where students may work at either paid positions or volunteer assignments. Specific arrangements must be made; these must take into account school policies, scheduling, and related matters. Arrangements also involve such matters as the number of students, duties, limitations, liabilities, responsibilities, timing, payment, and institutional restrictions. Continuous coordination is critical in order to "iron out" problems relating to calendar dates and coordinating schedules. Lastly, the importance of ongoing evaluation cannot be overlooked. Evaluative criteria need to be jointly established and applied. In summary, schools that reach out to the community normally will be involved in inventorying the community to determine the types of resources available, following up with firsthand contacts, collecting information regarding the sites, and evaluating the potential contribution of the resources to the school's instructional program.

Instructors—and the school in general—are responsible for organizing, planning, coordinating, and evaluating community and school programs. As far as the students are concerned, the roles will vary—and for many reasons. For example, students may be paid or unpaid, serve on an internship or apprenticeship, or be placed in an assistantship. Students are the link between the community and the school. The actual tie-in comes through regularly scheduled conferences and assessment reports in which students play a major role.

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Most electronics technician jobs in industry require considerable knowledge of electronics. There is very little that someone not versed in formal circuit theory could do. Consequently, on-the-job training, internships, apprenticeships, and the like are not always particularly popular means of training students in electronics. Witness the military electronics programs where, before the technician is allowed even the most trivial on-the-job work, several weeks of concentrated classroom training is needed. This is unfortunate since no better way exists to acquire certain participative work environment skills than to participate in a work environment whenever possible.

In medicine, the internship is routine—but only after students know medicine well are they allowed to practice it, and then only under supervision. On-the-job training is feasible in electronics after the first year of a 2-year program if the job requirements are minimal. Unfortunately, some employers are reluctant to give students positions such as these. Because typical students would not be very productive, their salary would be purely overhead—and no department wants more

overhead. Most technical activity in industry takes place from "8 to 5." Most electronics school programs also take place during that same time period. Dropping out of school for a 6-month industry internship would possibly extend a 2-year program to 3 or 4 years. Even if students could work from 8 to 5 and go to school at night, they would suffer due to lack of study time. Electronics students are expected to spend a minimum of 2 hours of study for each hour of lecture. Those who do, usually pass; those who do not, usually fail.

Electronics is simply too complex a subject for learning on the job. Compare it to medicine in this respect. No hospital would hire a junior premed student to diagnose and cure an illness. Similarly, not too many industries would hire a beginning electronics student to diagnose and cure circuit problems.

SELECTED RESOURCES

Resources on Quality of Work Life Objectives

Interpersonal and Other Human Relations Skills (Objective #1)

Division of Community Colleges and Career Education. *Curriculum Guide for Electricity-Electronics*. Salem: Oregon Department of Education, 1969.

You may not wish to use curriculum guides written nearly 15 years ago; however, if you look closely at this one, there are some valuable ideas presented in this instructional guide. For example, here are some "expected behaviors" you might wish to consider in the area of human relationships:

Required Knowledge	Expected Behaviors
Maintaining good human relationships	Recognize and demonstrate the following principles for maintaining good human relationshipswith fellow employees on a day-to-day basis: — Treat people as individuals — Recognize that human behavior is unpredictable — Don't pass the buck — Be loyal to others
Maintaining good human relations with supervisors	Demonstrate understanding that to build good human relations with supervisors one must: — Make good use of constructive criticism — Carry out assigned responsibilities — Recognize the supervisor as an individual — Contribute new ideas — Be loyal
Solving human relations problems	When faced with human relations problems, consider this four-step method: — Getting the facts — Stating the problem as shown by the facts

— Determining the possible solutions
— Weighing the advantages and disadvantages of each solution

(from *Curriculum Guide for Electricity-Electronics*, pp. 86-88)

Graham, G. H. *Understanding Human Relations: The Individual, Organization, and Management*. Chicago: Science Research Associates, 1982.

Chapman, E. N. *Your Attitude Is Showing: A Primer on Human Relations*. 4th ed. Chicago: Science Research Associates, 1983.

Chapman, E. N. *Put More Leadership into Your Style*. Chicago: Science Research Associates, 1984.

Johnson, D. W. *Human Relations and Your Career*. Englewood Cliffs, NJ: Prentice-Hall, 1978.

These related books should be a welcomed addition both for persons in business and industry and for instructors who are preparing students to enter business and industry. While a number of books are available on the general topic of human relations, the book by Graham is especially relevant to the purposes of this instructional guide. The second and third sections of the text, particularly, hit our target. Section 2, "Organizational Aspects of Human Relations," includes valuable chapters on organizational structure (including authority and responsibility), small-group behavior, and climate and organization development. Section 3, "Managing Human Relations," includes important chapters on the role of supervisors, how to lead effectively, how to improve communication, how to improve decision making, and how to implement change.

Chapman's primer on human relations, now in its fourth edition, focuses both on understanding yourself and relationships with others. This attractive paperback (with a smiling Mona Lisa on the cover) is also sprinkled throughout with 20 case problems on such topics as decision, communication, confrontation, frustration, listening, hostility, and sensitivity—to cite only a few.

Chapman's newest book deals primarily with leadership and includes sections on management skills, becoming a better communicator, handling power with care, and learning to make decisions with confidence. It, too, has similar case studies throughout the text, plus a valuable appendix that includes the author's response to the case problems, a leadership assessment form, and a leadership communication scale.

Although somewhat older, the Johnson resource is still valuable. This guide to interpersonal skills includes an insightful discussion on job survival skills: cooperating and leading, communicating, forming good relationships, making conflicts beneficial, and resolving conflicts through discussion.

Group Problem Solving (Objective #2)

The following references deal with various aspects of group problem solving:

Cinnamon, K. M., and Matulef, J., eds. *Applied Skills Series*. San Diego: University Associates, n.d.

Each volume in this series of four volumes contains 24 hours of result-oriented training designs that can be used in part or in whole. All forms are ready to use, can be duplicated without modification, and can be "mix and matched." Each volume in the series may be purchased individually. The two volumes that are most relevant to this guide are as follows:

Volume 2: Creative Problem Solving. The content includes recognizing a problem when and where it exists, anticipating difficulties during the problem-solving process, determining objectives or goals, establishing results desired when the problem is solved, generating creative and realistic solutions, evaluating alternative solutions against predetermined criteria, implementing the chosen solution in an organized manner, and evaluating the results.

Volume 3: Human Relations Development. Topics covered include options in interpersonal styles; accurate self-perceptions, awareness of others' values, attitudes, and goals; personal assumptions and the work setting; constructive feedback; empathy; dynamic listening; accurate identification of needs; developing trust; constructive confrontation; assertiveness; appropriate self-disclosure; and modeling.

Daggett, W. R., and Marrazo, J. *Solving Problems/Making Decisions*. Cincinnati: South-Western Publishing Co, 1983.

This text-workbook is designed to help students acquire the knowledge and ability to solve problems and make decisions. Students are provided with problem-solving activities and decision-making models to follow as they analyze themselves and compare their attributes for making career and life choices. End-of-chapter activities include short-answer questions, a vocabulary list, and a chapter summary.

Eggland, S. A., and Williams, J. W. *Human Relations at Work*. 2d ed. Cincinnati: South-Western Publishing Co., 1981.

This text-workbook offers students the opportunity to participate in a well-organized series of activities dealing with human relations. The workbook develops an understanding of and appreciation for human relations; encourages an understanding of oneself; helps students deal with fellow employees, employers, and customers; and develops links between human relations skills and communication skills. Written in an easy, informal style, the text is useful in any vocational program that prepares students for the world of work. It contains 6 chapters and 40 class activities that require approximately 30 hours to complete.

Fulton, P. J. *Exploring Human Relations*. Boston: Houghton Mifflin Co., 1982.

In this text-workbook, students learn the skills they need for success with people. They gain a clear understanding of the basic concepts of human relations, focusing on developing personal understanding, communicating with others, becoming an effective employee, and setting personal and career goals. Students participate in case studies, readings, group discussions, and role playing, all of which help build problem-solving and decision-making skills.

Herr, E L., ed. *Career Core Competencies*. New York: Gregg/McGraw-Hill Book Co., 1980.

Focusing on the basic core competencies required for successful employment and career satisfaction, the *Career Core Competencies* 4program helps students develop career maturity skills—nontechnical skills that relate to the understanding of themselves within educational, occupational, and social contexts. The program includes seven modules that are available separately or in sets; it is also available in one hardcover text entitled *Your Working Life: A Guide to Getting and Holding a Job*, which covers the most important coping skills and competencies presented in the modules. Each of the text-workbook modules, listed next, is divided into sections that combine theory, case studies, practical information, and hands-on exercises and projects. The modules are as follows: "Schools and Careers," "Knowing Yourself," "Making Decisions Work," "Working in Human Relations," "Getting the Job," and "Growing on the Job."

Russon, A. R., and Wallace, H. R. *Personality Development for Work*. 5th ed. Cincinnati: South-Western Publishing Co., 1981.

The title of this text reflects the concern for development of successful work habits and personality traits for all workers. Learning about oneself, dealing with attitudes, coping, communicating, and working are covered. Illustrations, including the use of mimes to pantomime personality characteristics, are included. Follow-up activities and case problems give students an opportunity to develop practical solutions to typical personal and work-related problems.

Coping in the World of Work:
Practice in Problem Solving (Objective #3)

Campbell, R. E.; Wynn, George A.; and Ransom, Robert M. *Coping in the World of Work: Practice in Problem Solving*. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1977.

This resource should be useful in preparing your students for the world of work. The valuable packet of materials is designed to assist students in the development of coping strategies that deal with work entry and job adjustment problems. The total packet is available as a classroom set with materials for 30 students or by individual components. The components include the following: an instructor's handbook, a student guide, masters for handouts, and a filmstrip and cassette program with scripts. The goals of this packet are very similar to the goals of this instructional guide.

namely, to acquaint students with typical on-the-job adjustment problems such as getting along with supervisors, dealing with tension, and work habits; to teach them a problem-solving approach to handle job adjustment problems, for example, diagnosing problems, developing solutions, and testing the solutions; to help them practice the problem-solving approach with simulated, but real, problems in the classroom; to help them learn and apply problem-solving methods to personalized problems outside the classroom; and to improve their communication skills through involvement in structured group activities and small-group discussions. In order to achieve these general goals, more specific behavioral objectives, called criterion objectives, are used. (Although the materials were developed for younger students, they can give the instructor many good ideas.)

Communication Skills (Objective #6)

Kraska, M. F. *Communication Skills for Trade and Industry*. Cincinnati: South-Western Publishing Co., 1985.

This new book is based on the premise that the ability to communicate effectively is necessary for the success of all those "who wish to become productive and active members of the modern industrial teams" (p. v). The author notes that the need to acquire effective communication skills is becoming increasingly evident for students, not only in their career function but also in preparing for changing job requirements. This text-workbook therefore addresses the needs of students for relevant communication skills in related vocational programs. As an integrated general communications approach to the subject matter, the text includes basic applications materials in written, verbal, and technical skills development.

The introductory chapters focus on basic sentence structure, punctuation, mechanics, and paragraph development. Specific occupational terminology is used in examples and test material in order to maintain student interest through displaying the relevance of communication skills in the workplace. Common terminology from the electrical and electronic, automotive, construction, and machine trades is employed. Examples are also taken from the study of physics, data processing, drafting, and metrics. After establishing the necessary written skills, in succeeding chapters the students are exposed to learning how to locate technical information and how to master verbal skills.

The instructor's manual and key that accompany the text contain a variety of teaching suggestions, lesson plans, transparency masters, and evaluation procedures. All in all, then, this text-workbook appears to provide the tools for students to accomplish the author's goals, which—in her own words—are as follows: "Today's working environment demands that trade and industrial personnel must not only master specific trade proficiencies, but must also possess a good working knowledge of related communication skills. This basic ability will also enable the trades person to prepare for career enrichment as industrial needs change in a fast moving workplace" (p. vi).

Williams, J. W., and Eggland, S. A. *Communicating at Work*. Cincinnati: South-Western Publishing Co., 1979.

This text-workbook will help students to communicate more effectively at work. It contains illustrations, exercises, and end-of-chapter class activities designed to aid them in practicing effective communication. Approximately 30 hours are required to complete the workbook. The updated

version of a companion workbook, entitled *Communication in Action*, is due for release in late 1984.

Reasoning and Thinking Skills (Objective #7)

Educational Leadership (Association for Supervision and Curriculum Development) 42, no. 1 (September 1984): entire issue.

This entire issue deals with and bears the title "Thinking Skills in the Curriculum." In an overview of the issue, the editor writes that "a fully adequate curriculum . . . should provide for teaching *of* thinking and *about* thinking as well as teaching *for* thinking. Planning such a curriculum is complicated by the diversity of approaches and the kinds of thinking sought in various programs" (p. 3). Here are some of the articles to be found in the magazine: "Critical Thinking Is Not Enough"; "Kinds of Thinking Taught in Current Programs"; "How Can We Teach Intelligence?"; "The Key to Higher Order Thinking Is Precise Processing" ("Teachers can focus on thinking skills by having students describe their mental processes and giving them feedback on erroneous or incomplete reasoning" [p. 67]); and "How to Keep Thinking Skills from Going the Way of All Frills" ("Success in teaching thinking skills results when content objectives are contingent on activities that also promote thinking and when thinking skills permeate the entire curriculum" [p. 75]). For those who wish to infuse problem-solving methods into their teaching, reading this journal from cover to cover is a must.

Organization and Management:
Economics-related Competencies (Objective #8)

Clawson, E. U. *Our Economy: How it Works*. 2d ed. Menlo Park, CA: Addison-Wesley Publishing Co., 1984.

This text introduces important economic principles through studies of the production of familiar goods. It is written in a style that can be easily understood by both junior and senior high students. The text includes student involvement activities in fact finding, analysis, decision making, and role playing. A related text-workbook supplement, entitled *Our Economy: How It Works, Activities and Investigations*, is also available.

Ford, L. G. *Economics: Learning and Instruction*. Cincinnati: South-Western Publishing Co., 1982.

This textbook is a practical how-to manual that divides economic theory into eight simplified, yet comprehensive concept areas: alternative economic systems, supply and demand, income, profits, spending and saving, fiscal policy, the Federal Reserve system, and international economics. Teaching applications follow the presentation of theory, illustrating which theory should be covered and how to present it.

Heilbroner, R., and Thurow, L. *Economics Explained*. Englewood Cliffs, NJ: Prentice-Hall, 1983.

Two of America's most respected economists have written this basic, jargon-free guide to help students better understand how economics directly affects their lives. It covers such issues as inflation, unemployment, interest rates, investing, and saving.

Miller, R. L. *Economics Today and Tomorrow, Enterprise Edition*. New York: Harper and Row Publishers, 1975.

This is a clearly written textbook program that promotes student awareness and understanding of how the U.S. economy works. The book develops economic skills, relates theory to real-world situations, examines current economic issues, and profiles important economists. It is combined with a sequential development of reading, writing, statistical, speaking, and study skills. Case studies and discussion questions are also provided.

Peterson, H. C. *Economics of Work*. Cincinnati: South-Western Publishing Co., 1983.

This text-workbook is designed to help students gain a better understanding of our system of economics. It will help students make the natural linkage between the overall structure of the economy, how it functions, and how workers play a meaningful role in the input side of the economic process. Students will gain an understanding of the role of the individual within a firm, the role of a firm within the economic system, and the interrelationship of government and private enterprise. Students will be exposed to various types of economic problems and will be asked to apply economic concepts to the decision-making process in order to gain an understanding of the economic system.

Quality Circles and Quality of Work Life (Objective #8)

Dewar, D. L. *Leader Manual and Instructional Guide*. Red Bluff, CA: Quality Circle Institute, 1982a.

Dewar, D. L. *Member Manual*. Red Bluff, CA: Quality Circle Institute, 1982b.

Thompson, P. C. *Quality Circles: How to Make Them Work in America*. New York: American Management Associations (AMACOM), 1982.

Harshman, C. L. *Quality Circles: Implications for Training*. Information Series no. 243. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Lloyd, R. F., and Rehg, V. R. *Quality Circles: Applications in Voc Ed*. Information Series No. 249. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1983.

Owens, D., and Horvath, Y., eds. *Quality Circles and Quality of Work Life: Directory of Resources*. Milwaukee: American Society for Quality Control, 1981.

These six resources all deal with aspects of the quality of work life concept. According to Dewar, "A quality circle is a group of people who voluntarily meet together on a regular basis to identify, analyze, and solve quality and other problems in their area" (1982b, p. 1). The technique, which originated in Japan, is becoming more widespread in this country as the growing number of books and articles on this topic testify. The six resources noted here, needless to say, represent only a small sample of the available materials for both educators and industrialists. The following paragraphs briefly highlight the nature of these materials:

Dewar's *Leader Manual and Instructional Guide* is precisely what it says it is, namely, a guidebook for establishing and conducting quality circles. The guide includes valuable techniques and suggestions, questions and answers, case studies and ideas for problem prevention, decision analysis methods, cause and effect problem analyses, and the like. The *Member Manual*, the companion document, contains similar information but is, of course, intended for use by the group members.

Thompson's book presents initial background information on the process and then focuses on installing quality circles—strategies and implementation, training, preparing the organizations, and working out the details.

The two publications of the National Center for Research in Vocational Education are also practical guides for understanding the process. Harshman, for example, lists various goals for and steps in implementing quality circles, principles of operation, training concerns, and the like. Lloyd and Rehg look at the concept—at participative decision making, goal setting, and team building—as well as at specific applications of quality circles in vocational education, including suggested quality circles curriculum and a 1-year quality circles course.

The *Directory of Resources*, although several years old, still includes many valuable leads on companies using quality circles and relevant resources and periodicals on that topic. In addition, the directory includes extensive information on the quality of work life concept, which is defined as "a process by which an organization attempts to unlock the creative potential of its people by involving them in decisions affecting their work lives" (p. 37). Lists of resource organizations, technical literature, bibliographies, and audiovisual materials are cited.

Courses on Quality Control and Quality of Work Life (Objective #8)

Without doing a formal survey, it is not possible to tell how many community colleges offer a course sequence in quality control. However, Triton College in Illinois does. (The address is 2000 Fifth Avenue, River Grove, Illinois 60171.) One might wish to write for the details of the option and for more specific information regarding course objectives, learning activities, resources used, and so on. Here are the courses offered in this sequence:

- **Quality Control Fundamentals I**
  Lecture—3 hours
  This course on quality control nomenclature, functions, and practices emphasizes quality control manuals and specifications, including many governmental publications.

- **Dimensional Metrology I**
  Lecture—2 hours; laboratory—4 hours
  This course provides an opportunity to get a practical and theoretical understanding of many types of mechanical and optical precision measuring devices.

- **Dimensional Metrology II**
  Lecture—2 hours; laboratory—4 hours
  Electrical measuring devices and their application to industrial measurement are covered.

- **Quality Control Fundamentals II**
  Lecture—3 hours
  Designing and interpreting control charts, statistical sampling plans, related industrial and governmental publications, vendor evaluation and certification, and "zero defects" are stressed in this course.

- **Materials Testing**
  Lecture—2 hours; laboratory—4 hours
  Federal and industrial test standards and principles for mechanical testing are covered. Laboratory experience provided includes the use of hardness, tensile, spectrometer, thickness, magnetic and weld inspection equipment.

- **Quality Control Inspection**
  Lecture—3 hours
  Drawing review, contract review, formulation of a quality control plan, review processes, inspection, and documentation are addressed.

- **Quality Control Engineering**
  Lecture—3 hours
  Formulation of a quality policy, quality analysis, planning, information feedback, and process engineering are the topics of this course.

- **Quality Control Management**
  Lecture—3 hours
  This course is an exercise in the formulation and administration of a complete quality control regime.

Using Quality Circles in the Classroom (Objective #8)

Hirshfield, C. "Quality Circles in the Classroom: An Experiment in the Pedagogical Uses of Japanese Management Methods." Paper presented at the annual conference of the association, Williamsburg, VA, Eastern Community College Social Science Association, 23-26 March 1983.

An ongoing experiment in the use of the quality circle concept of consensus and group management has been conducted at the Ogontz Campus of Pennsylvania State University. Quality circles composed of the instructor and 8 student volunteers meet weekly for 45 minutes, with each member informing 3 other students of quality circle activities and soliciting suggestions from them. Initial meetings consist of a description of the functioning of quality circles and the development of a code of ethics for the group. Subsequent meetings focus on details of classroom routine and management, the content of the course, and methods of presenting the subject matter and increasing class participation. All of the judgments of the group on these matters are accepted as final and are implemented in the classroom. Brainstorming and cause and effect diagrams, normally associated with industrial models, are used in the quality circle sessions. As a result of the quality circles, contact between the instructor and students was increased, students were convinced that they and their input were important, a bonding occurred among quality circle members, the classes became more responsive, and students' decision-making and problem-solving skills—as well as their willingness to assume responsibility and obligation—were enhanced.

The following is a brief section of the paper that is highly relevant to this guide:

> In 1981 Lane Community College in Oregon became the first institution of higher education to underwrite the training of staff members as facilitators and to establish a network of campus circles meeting weekly to seek solutions to the everyday problems of work life.
>
> The experiment at Lane is in its initial phase and results are not yet available. However, there is little doubt that the quality circle philosophy can be adapted to a variety of situations, one of these being the classroom itself—a place where, strangely enough, it has not yet been much in evidence. Resting as the concept does on the premise that everyone who feels the impact of a decision must be involved in making it, it seems logical that the classroom, whether in the senior high school or the university, might be a potentially significant testing ground. Circle volunteers, according to industrial managers, derive an enhanced sense of responsibility from participation, along with an unparalleled opportunity for personal growth and recognition. Such obvious congruence with the goals which educators, too, pursue is clearly enough to justify the introduction of the quality circle into the classroom, at least on an experimental basis. Indeed, if one simply substitutes the word "student" for the term "worker" in the considerable volume of quality circle literature which has been appearing in past months, one becomes acutely aware of how truly ideal a laboratory the individual classroom may be and how easily its traditionally teacher-centered atmosphere may be democratized by the introduction of Japanese concepts of consensus and group management. (pp. 4-5)

Participative Management Program in Industry

A Discussion of the Motorola Participative Management Program. Schaumburg, IL: Motorola, 1981.

It is likely that some graduates will join major companies in the electronics industry. When they do, they will surely be involved in activities such as the participative management program of Motorola, a leader in electronics with specialties in semiconductor technology, portable and mobile communications, automobile and industrial electronics, government electronics, and data communications.

In an effort to compete successfully, the company is striving constantly to improve the business techniques and standards that have been the foundation of the company's success. Specific areas of focus in this effort include a renewed emphasis to improve quality, production, and service. In order to accomplish this, the management believes very firmly in the need for involved, motivated employees.

The following brief descriptions from a Motorola publication illustrate what students should expect.* While reading these items, **think of all the ways that they can begin to be prepared for the roles they will need to assume**.

First, they must understand the three major assumptions upon which participative management is based:

- An individual's behavior is primarily the consequence of the treatment received. If an individual is treated as an intelligent, involved, and responsible person and the expression of the individual's ideas regarding improvements in the work or in the organization is respected and encouraged, those qualities will be maximized and the organization will benefit. . . .

- Every individual needs and expects to live in a rational working world. Managers must be open to competent, constructive influence. Their decisions must appear and be proven to be rational and reasonable. If that is true, then all employees will have confidence that their workday assignments of schedule, materials, and equipment have been well thought out and their ability to perform at full capacity without interference or frustration will be enhanced. . . .

- Every individual's effectiveness depends on how aware the employee is of the interdependent relationship between the company and the job. This assumption requires that employees understand what is expected of them. This expectancy is not the autocratic command of the supervisor or manager. Rather it is the expectancy and insistence of a customer who demands the best value and performance when purchasing a product or service. (p. 3)

Program requirements. Every manager must accept the responsibility to share the problems and opportunities with employees, and to draw out their ideas. What is required is to mobilize employee talents regarding company goals, from the top all the way through each operating unit. "The program is not a panacea, nor is it a substitute for good management fundamentals. It is not a pat formula or set of procedures to be applied mechanically with the expectation of automatically achieving a totally cooperative and productive system" (p. 4). The program, among other things, requires the following:

- Encouragement and support of teamwork, idea sharing, and mutual trust

- Two-way communication about goals and objectives, how to achieve them, and specific progress toward them

- Decision making at the most appropriate level

- Employee responsibility; that is, direction, discipline, and control are generally self-motivated and not externally imposed

*This material, from the resource *A Discussion of the Motorola Participative Management Program*, was used with permission of Motorola Inc., 1981.

Program format. In participative management, participants function in "teams" that work cooperatively toward achieving goals. They do not act as individuals competing with each other, nor do teams compete with one another. The approach is based on a comprehensive team effort, with each participant's contribution affecting the entire team and each team's contribution affecting the company.

The teams satisfy their responsibilities through established committees that perform several functions. "Improvement teams" assist in establishing goals and in identifying and solving problems that interfere with the realization of those goals and that are within the team's capacity to resolve or influence. "Steering committees" oversee the problem-solving process and monitor team performance.

Each team has a set number of performance goals. When these "goals are met or exceeded, all members of the team receive a bonus based on the same percentage of each participant's eligible compensation. When goals are not met, no one on the team receives a bonus. However, the base salary is always earned; individual compensation can never be lower than that base, regardless of the team's performance" (p. 5).

Actually, the program at Motorola consists of two separate parts: Plan I participants are those involved in manufacturing aspects; Plan II participants consist of managerial, supervisory, and nonsupervisory employees who work in indirect support and nonmanufacturing positions.

Requirements for success. In addition to management commitment, which is, of course, essential, three elements are also critical: participation, communication, and trust.

- **Participation** is conceived as acceptance by all employees of the responsibility for the mandate and opportunity to influence the decision-making process, including accountability for one's own job and to all who have a stake in the company's success. It also means using the employee's unique knowledge to suggest better ways to do the job.

- **Communication**, closely related to participation, is the process by which meaningful participation is realized. Certain conditions are necessary for employees to feel comfortable communicating their questions and recommendations. The program, therefore, incorporates several methods designed to provide each individual the opportunity to participate in the communication process.

  An example of communication is the "I Recommend" plan. Each work area has an "I Recommend" board easily accessible to all. Forms are placed there on which employees may write recommendations. (They can sign the form or not.) The bottom half provides a place for answers. The recommendation and answer are posted on the board. "The form includes the name of the person who is working on the solution and the date. . . . All 'I Recommends' must be answered within 72 hours. Where a final answer is not possible within that time, a commitment for a final date must be given" (p. 10).

- **Trust** is broken down into two components: "line-of-sight" and "equity." The former is provided when participants have the opportunity to see that their actions can affect their team's performance. By keeping teams small and structuring them around work functions (departments, production lines, or office staffs), the program seeks to provide adequate "line-of-sight." "Equity" is addressed by the bonus structure. "Bonuses are calculated on the basis of a percentage of eligible compensation. This enhances the equity of the bonus system because it rewards the different amounts of skill, experience and education . . . which employees bring to the job" (p. 10).

Preparing for the program. The company has also considered several preparation approaches since participative management requires a good deal of time and effort. *Readiness* must be consciously developed. Some of the main ideas include the following:

- Senior managers must assume responsibility for watching market conditions as well as social and political forces. They must be aware of relevant changes and be able to modify the company's practices accordingly. They must then make the employees aware of how changes affect the organization.

  Lastly, they must work to keep lines of communication open in all directions.

- Trust is a fundamental precondition but is difficult to attain. When managers are authoritarian, change often is viewed with distrust. Hence, managers must demonstrate an ability to listen and a willingness to change.

- First-line supervisors should begin by reading about participative management and analyzing their own leadership style. "Some managers may find that they do not have the necessary communication and human relations skills to function within participative management. This may occur at any level. These individuals will require additional training." (p. 11).

In short, accomplishing participative management objectives takes considerable time. Building trust and changing leadership style does not grow overnight. Although these tasks are not impossible, for even greater success, the approach described here should be considered as part of "preservice" training in electronics (as in other occupational areas). **Readiness assuredly can begin at the training level if it is believed there is room for these concepts in the instructional approaches. Problem solving and decision-making skills are not "caught." They must be explicitly woven into the curriculum and consciously "taught."** For additional information about the program, write to Motorola, Inc., Motorola Center, 1303 East Algonquin Road, Schaumburg, Illinois 60196.

Another electronics company that has developed quality circle information useful in preparing students for the reality of the work world is the Matsushita Industrial Company (9401 West Grand Avenue, Franklin Park, Illinois 60131). The company has developed a packet of in-house training materials dealing with such topics as group dynamics, creativity, brainstorming, process cause and effect, and the like. They have also utilized training materials developed by the Quality Circle Institute (1425 Vista Way, P.O. Box Q, Red Bluff, California 96080).

Resources on Instructional Approaches

Research and Experimentation

Berlin, H. M. *Experiments in Electronic Devices*. Columbus, OH: Charles E. Merrill Publishing Co., 1984.

Floyd, T. L. *Essentials of Electronic Devices*. Columbus, OH: Charles E. Merrill Publishing Co., 1983.

The text by Floyd is intended as an overview, either at the end of a DC/AC sequence for students or as a brief one-term course for either major or nonmajors in electronics. The laboratory workbook by Berlin, however, is designed to be used in conjunction with Floyd's text—or with virtually any other text on semiconductors that may be used at the electrical and electronics technology level. The range of experiments presented is designed to reinforce and expand upon the concepts presented in the classroom. The student is able to verify these concepts by performing detailed, step-by-step experiments that are accomplished in a typical 2- to 3-hour lab session. In all cases, experimental measurements can be reasonable compared with theory. At the end of each experiment is a separate data page, and, when required, a blank graph page is also provided. All of the experiments have been performed by the author for accuracy in a electronics engineering technology program at a community college. Hence, the resource should be highly valuable in this experimentation approach.

The Charles E. Merrill Publishing Company has also published B. H. Stanley's *Experiments in Electric Circuits* (1982) to accompany Floyd's *Principles of Electric Circuits* (1981) and *Electric Circuits: Electron Flow Version* (1983).

Individualized Instruction

Report of Electronics Technology Curriculum Development Project. Grant Number GY-6182. Washington, DC: National Science Foundation, 1971.

Although this report of the work of seven community colleges dates back to the early 1970s, it contains a good deal of still relevant information on electronics technology curriculum and instruction. In addition to such topics as curriculum development, course sequence, and equipment, the report includes sections on individualized instruction. Recommendations were made that in order to improve learning, instructors must change directions along the following lines:

Move away from	**Move toward**
memorization of information	comprehension and understanding
lectures	self-directed study
group instruction	more individualized instruction
cookbook lab experiments	creativity and discovery
presentation of facts	development of attitudes

The report also stresses the importance of planning and the idea that planned instruction does not necessarily lead to rote learning. "When properly designed, structured lessons can lead to highly meaningful learning of concepts which will be useful for . . . problem solving. For example, discovery or inquiry experience should be a part of audio-tutorial lessons" (p. 209).

The concept of audiotutorial instruction is dealt with in great detail. This type of instruction is defined as follows: "A technique which uses audio-tape recordings to present some part of the instructional materials in a unit of study" (p. 236). It is more than a canned version of the traditional lecture in that the method coordinates a multimedia approach for independent instruction. Information is presented on steps for preparing audiotutorial lessons, and the advantages, disadvantages, and applications of the method.

Two other instructional methods discussed in detail are computer-assisted instruction (CAI) and the learner-controlled laboratory. As all instructors know, the former refers to "a branching program developed for a specific course or segment of a course, programmed on a computer so that a student may interact with it through some type of remote console" (p. 264).

The learner-controlled laboratory is a title used to identify electrical and electronic technology laboratories that use the autotutorial teaching method described as follows:

> This self-teaching method, which emphasizes individual study, is made possible by the development of low-cost audiovisual equipment. . . . The method has been used successfully in complete courses that include classroom and laboratory sessions. This explanation, however, is for laboratory courses that support the classroom activities. The success of [the approach] is based on the actual operation of the audiovisual instructional equipment by the student, not the instructor. The student operates the tape player and slide projector during the performance of experiments in the laboratory. The purpose of the use of multiple instructional media is to provide the student with the opportunity for self-teaching and experimentation. (p. 237)

In this approach, the instructor plays a different role, as noted: "Students obtain the basic instructions from the audio tapes and slides, which leaves the instructor free to work with the students on real problems rather than assisting with the wiring of circuits, step-by-step explanations, explanations of instrument operational procedures, and troubleshooting" (p. 238).

Performance-based Approach

Resource Guide for Performance-based Electricity/Electronics Instruction. College Park: Department of Industrial Education, University of Maryland, 1977.

This monograph provides numerous resources for instructors who are interested in implementing a performance-based approach to teaching electronics and electricity. The first section, "How to Develop a Performance-based Instructional Program," deals with such topics as task analysis, performance objectives, criterionreferenced measurement, program characteristics, using an instructional systems approach, and examples of curriculum resources. The remainder of the text includes extensive lists of both print and audiovisual resource materials. One of the items cited is a "Training Achievement Record" used in various **Corpsmember Activity Guides** (CAGs) by the Job Corps. Note the following relevant list of "attitudes and professional ethics" that are considered important for students to develop:

- Demonstrate correct safety practices on the job
- Maintain appropriate personal hygiene and appearance
- Arrive at the job on time
- Be on the job every day
- Perform work of consistently good quality
- Function cooperatively with fellow workers
- Treat others courteously
- Work with even temperament
- Accept constructive criticism
- Follow instructions willingly

- Deal well with supervision
- Willingly work unusual schedules when required
- Handle proprietary information discreetly
- Respect confidences
- Respect worth of equipment, company, and personal property

Performance-based Teacher Education

Performance-based teacher education (PBTE) is an approach to teacher preparation in which the instructor is required to demonstrate essential teaching tasks in an actual teaching situation. Actual performance of the tasks ensures that the instructor has not only the knowledge required, but also the ability to perform the competencies that are essential to successful teaching. PBTE, among other tools, uses **modularized materials** that integrate theory with practice.

A number of **modularized materials** have been developed by the National Center for Research in Vocational Education at The Ohio State University and are available through the American Association for Vocational Instructional Materials at The University of Georgia. Each module is an instructional package designed to cover a single teaching skill. The package contains a series of learning experiences that provide information, activities, and feedback devices to help the instructor acquire the skill. Most modules also suggest optional outside references and learning activities.

Two types of materials have been produced: the 100 modules in 10 professional skill categories and a set of printed and audiovisual materials specifically designed for orientation and training of teachers, resource persons, and others using the materials. All printed materials are low cost, paperback, 8 1/2" by 11", and three-hole punched. The modules and student guide are designed to be consumable, and the pages are perforated for easy removal and use.

Category C—Instructional Execution—is particularly relevant to many parts of this instructional guide. The 29 modules in this category focus on the competencies involved in providing classroom and laboratory instruction. The modules are designed to prepare the instructor to use the wide variety of instructional strategies in directing individual and group learning activities.

A quick look at some of the titles will indicate just how relevant the modules are to this guide:

- C-2 *Conduct Group Discussions, Panel Discussions and Symposiums*
- C-4 *Direct Students in Instructing Other Students*
- C-5 *Employ Simulation Techniques*
- C-6 *Guide Student Study*
- C-7 *Direct Study Laboratory Experience*
- C-8 *Direct Students in Applying Problem-Solving Techniques*
- C-9 *Employ the Project Method*
- C-14 *Provide Instruction for Slower More Capable Learners*
- C-15 *Present an Illustrated Talk*

- C-16 *Demonstrate a Manipulative Skill*
- C-17 *Demonstrate a Concept or Principle*
- C-18 *Individualize Instruction*
- C-20 *Use Subject Matter Experts to Present Information*
- C-21 *Prepare Bulletin Boards and Exhibits*
- C-22 *Present Information with Models, Real Objects and Flannel Boards*
- C-23 *Present Information with Overhead and Opaque Materials*
- C-24 *Present Information with Filmstrips and Slides*
- C-25 *Present Information with Films*
- C-26 *Present Information with Audio Recordings*
- C-27 *Present Information with Televised and Videotaped Materials*

In addition, a number of other modules also are relevant to this guide:

- A-6 *Develop Program Goals and Objectives*
- A-8 *Develop a Course of Study*
- B-2 *Develop Student Performance Objectives*
- B-3 *Develop a Unit of Instruction*
- B-5 *Select Student Instructional Materials*
- B-6 *Prepare Teacher-made Instructional Materials*
- D-1 *Establish Student Performance Criteria*
- D-2 *Assess Student Performance Knowledge*
- D-3 *Assess Student Performance Attitudes*
- D-4 *Assess Student Performance Skills*
- F-5 *Assisting Students in Applying for Employment for Further Education*
- G-8 *Work with Members of the Community*
- J-1 *Establish Guidelines for Your Cooperative Vocational Programs*
- J-3 *Enroll Students in Your Co-op Program*

- J-4 *Secure Training Stations for Your Co-op Program*
- J-5 *Place Co-op Students on the Job*
- J-7 *Coordinate on the Job Instruction*
- J-8 *Evaluate Co-op Students On-the-Job Performance*
- K-3 *Organize Your Class and Lab to Install CBE*
- L-3 *Plan Instruction for Exceptional Students*
- L-8 *Improve Your Communications Skills*
- M-1 *Assist Students in Achieving Basic Reading Skills*
- M-3 *Assist Students in Improving Their Writing Skills*
- M-4 *Assist Students in Improving Their Oral Communication Skills*
- M-5 *Assist Students in Improving Their Math Skills*
- M-6 *Assist Students in Improving Their Survival Skills*

Teaching Instructional Units and Instructional Worksheets

Robertson, L. P. *Basic Electronics I*. Stillwater, OK: Mid-America Vocational Curriculum Consortium, 1980.

Willison, N. A., and Shelton, J. K. *Basic Electronics II*. Stillwater, OK: Mid-America Vocational Curriculum Consortium, 1981.

These two volumes undoubtedly are among the most comprehensive electronics technology curriculum materials developed in the past 10 years. Volume 1 focuses on the basic principles of electricity and electronics and the fundamentals of direct and alternating current. The 15 units of volume 2 include rectifiers, filters, logic devices, logic systems, oscillators, transmitters, and so on. The introductory materials for each are quite similar in that the various units include behavioral objectives, suggested teacher activities, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the test. A relatively limited number of performance terms are used in the objectives in order to promote clearer communication. Some of the terms are relevant to the objectives of this instructional guide, for example, **describe** (discuss in writing, discuss orally, interpret, explain), **distinguish** (discriminate), and **demonstrate** (show your work, perform an experiment, perform the steps, and so on).

Each unit has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. The authors, for example, suggest that instructors should follow these steps: provide students with objective sheets, information sheets, assignment sheets, and job sheets; preview

filmstrips and make transparencies; arrange for resource materials and people; discuss the unit's specific objectives and information sheet; and give a test. Instructors are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Since this instructional guide talks about the instructional worksheet method, let us take a brief look at how that approach is described in these two volumes.*

- The **information sheet** provides content essential for meeting the cognitive (knowledge) objectives of the unit. The teacher will find that the information sheet serves as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective. Students should read the information sheet before the information is discussed in class. Students may take additional notes on the information sheet. (Robertson, p. xii; Willison and Shelton, p. xiii)

- **Assignment sheets** give direction to study and furnish practice for paper and pencil activities to develop the knowledges which are necessary prerequisites to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress. (Robertson, p. xiii; Willison and Shelton, p. xiii)

- **Job sheets** are an important segment of each unit. The instructor should be able to and in most situations should demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for a student to follow if she/he has missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances he/she might reasonably expect from a person who has had this training. (Robertson, p. xiii; Willison and Shelton, p. xiii)

Siebert, L. N., and Pierce, G. *Introduction to Industrial Electricity—Electronics*. Stillwater: Curriculum and Instructional Materials Center, Oklahoma State Board of Vocational and Technical Education, 1981.

As an addition to the volumes described above, this comprehensive manual provides a basic core of instruction for both industrial electricity and industrial electronics. The major sections deal with electron theory, circuit theory, test instruments, basic electronic components, and fabrication skills. The authors suggest that the information presented should be modified to coincide with local conditions and supplemented by the instructor's own methods and materials. The introductory materials explain the use of performance objectives, information sheets, assignment sheets, and job sheets in basically the same fashion as the other two volumes. In addition, it presents these suggestions for "teaching methods": "It is a challenge to keep students motivated. Supplement the objectives by providing the 'why,' personal experiences, and current information. Prepare for each unit by deciding how each objective can be taught best. Allow students to become involved in preparing and planning" (p. xiv).

*These three descriptions are reprinted with the permission of the Mid-American Vocational Curriculum Consortium, Inc., copyright 1980 and 1981, as indicated.

Developing Case Studies

Specific resources that contain only case-study problems are not widely available. However, some case-study problems are found in the form of discussion questions at the end of chapters in textbooks or as special activities in workbooks. In addition, here are two general resources on the approach.

Canei, R. A. *Decision Making for Young Executives*. Columbus: Instructional Materials Laboratory, The Ohio State University, 1979.

This manual suggests several methods of decision making and provides cases as samples for problem solving. It is based on Ohio's Team Management Decision-making Competitive Activity.

Canei, R. A. *Human Relations Cases*. Columbus: Instructional Materials Laboratory, The Ohio State University, n.d.

Included in this manual are 55 cases for use with the entire class, small groups, or as individual projects. With each case is a competency that might assist in the solution of the case. Also listed with each case are some "Points to Consider" to help the instructor think about all the possibilities involved.

Entrepreneurship Approach

Ashmore, M. Catherine, and Pritz, Sandra, comps. *PACE Revised: Program for Acquiring Competence in Entrepreneurship*. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1983.

Many good materials exist that can be used to teach about entrepreneurship. One of the most comprehensive is the set of materials developed by the National Center for Research in Vocational Education. The *PACE* materials are modularized, competency based, and are available in three levels of learning:

- **Level 1** is for secondary vocational or prevocational programs. Students gain entry-level knowledge of concept, terms, and planning needed to open a small business, as well as awareness of entrepreneurial career options. (Reading level: 7th grade)
- **Level 2** is for advanced secondary and postsecondary programs. Students become familiar with the principles of entrepreneurship, and develop detailed plans using existing businesses as sources of information. (Reading level: 9th grade)
- **Level 3** is for advanced postsecondary or adult education. Students develop competencies in policymaking, strategies, and management of small business. These units build on previous knowledge and experience. (Reading level: 10th grade)

Eighteen specific *PACE* instructional units are available; the sets at each level contain one module per unit title. Instructor's guides are also available, which include unit objectives, teaching outlines, transparencies, and the like. In addition, a resource guide includes a glossary of business terms, bibliographies, film resources, important addresses, and so on.

Here is the complete list of modules:

- "Unit 1—Understanding the Nature of Small Business"
- "Unit 2—Determining Your Potential as an Entrepreneur"
- "Unit 3—Developing the Business Plan"
- "Unit 4—Obtaining Technical Assistance"
- "Unit 5—Choosing the Type of Ownership"
- "Unit 6—Planning the Marketing Strategy"
- "Unit 7—Locating the Business"
- "Unit 8—Financing the Business"
- "Unit 9—Dealing with Legal Issues"
- "Unit 10—Complying with Government Regulations"
- "Unit 11—Managing the Business"
- "Unit 12—Managing Human Resources"
- "Unit 13—Promoting the Business"
- "Unit 14—Managing Sales Efforts"
- "Unit 15—Keeping the Business Records"
- "Unit 16—Managing the Finances"
- "Unit 17—Managing Customer Credit and Collections"
- "Unit 18—Protecting the Business"

The National Center also has other materials in this area. Here are just two brief examples:

Davis, L., and Zelinko, M. A. *Entrepreneurship in Voc Ed: A Guide for Program Planning*. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Assists program planners in selecting entrepreneurship materials. Users will become aware of a variety of curriculum materials, learn to select appropriate ones, learn to identify essential elements of entrepreneurship programs, become aware of alternative approaches, and learn how to develop a program plan. Explores eight curriculum resources in depth, including samples of content.

Hanson, G. A. *Entrepreneurship: A Career Alternative. Columbus: The National Center for Research in Vocational Eduction, The Ohio State University, 1983.*

Investigates the literature to provide resources for teaching entrepreneurship skills. Details personal characteristics of entrepreneurs, lists nine factors to consider in selecting a venture, and outlines steps in the start-up process. Describes nine areas in which entrepreneurial skills can be improved.

Lastly, three other resources for those who wish to explore entrepreneurship in more depth are as follows:

American Enterprise Series. Austin: Extension Instruction and Materials Center, The University of Texas at Austin, 1976.

This series, consisting of an instructor's guide and student's mannual for each unit, is self-contained and can be used as a third-year high school or community college curriculum. Competency-based units cover the information needed to own, operate, or manage a business enterprise. They can be used as a series or as individual units. The six units in the series are: "Financial Management," "The Management Function," "The Marketing Function," "Merchandising and Buying," "The Promotion Function," and "The Selling Function."

Hutt, R. W. *Creating a New Enterprise*. Cincinnati: South-Western Publishing Co., 1982.

This text-workbook, requiring 15-30 class hours for completion, enables students in a wide variety of classes to study and understand entrepreneurship. It is designed basically to introduce the concept of entrepreneurship, present entrepreneurship as a career path, and provide a realistic framework for starting a business. An instructor's manual is included.

Hutt, R. W. *Discovering Entrepreneurship—Filmstrips and Cassettes*. Cincinnati: South-Western Publishing Co., 1982.

The information presented in this set of four filmstrips and accompanying cassettes can be used to enhance the study of *Creating a New Enterprise* or it can be given as a separate audiovisual presentation. The material explains the world of the entrepreneur, roads to entrepreneurship, legal forms of business enterprise, and procedures for planning a new enterprise. An instructor's manual is included.

Numerous publications on this topic are also available from the Small Business Administration. Here is the address for SBA Publications: P.O. Box 15434, Fort Worth, TX 76119.

Audiovisual Media

The following is a brief selection of some commercial audiovisual (AV) materials that relate to nontechnical skills; the first three resources are available from most of the larger public and university libraries and will help to locate films and video programs.

Educational Film Locator of the Consortium of University Film Centers. 2d ed. New York: R. R. Bowker Co., 1980.

The Educational Film Locator is a listing of titles held by member libraries of the Consortium of University Film Centers, and a compilation and standardization of their 50 separate catalogs, representing about 220,000 film holdings with their geographic locations. *The Locator* is presented as a selective compilation of approximately 40,000 film titles that have been selected by 50 university film library staffs in response to demands from hundreds of thousands of educators from over

75,000 organizational users. This book allows the user three primary approaches to accessing information: by subject, title, and series. In order to facilitate the search process, *The Locator* provides six sections: "Major Subject Grouping"; "Subject Heading and Cross Index to Subjects"; "Subject, Title, and Audience Level Index"; "Alphabetical List of Film Descriptions"; "Series Index"; and "Foreign Title Index." Additionally, a number of special features, such as holdings statements and standard identification numbers for each title, as well as a producer and distributor directory, are included.

"Decision-Making Skills." Mount Kilso, NY: Guidance Associates, n.d.

This program of three filmstrips, three cassettes, a library kit, and teacher's guide helps students understand how values relate to decision making. They learn to find relevant information and to choose the best of the available alternatives. Students first learn the three steps of decision making: determining their personal values, gathering information, and planning a strategy. A dramatized vignette focuses on a young woman as she attempts to decide what she wants. The woman decides which questions to ask and begins to distinguish between decision making and problem solving. The next segment deals with her efforts to gather information about choices, to list alternatives, to do appropriate research, and to seek advice. Students are shown how to weigh risks and probabilities and explore the strengths and weaknesses of four major strategies for making decisions.

The Film File. 3d ed. Minneapolis: Media Referral Service, 1983-84.

This book is the only film and video resource guide that's completely updated annually. Audiovisuals listed in the file are from distributors' catalogs, supplements, new release announcements, and so forth; and it claims to be the most current and comprehensive film and video selection guide available. The third edition lists over 10,000 current film and video titles available from 110 U.S. and Canadian distributors. Titles are indexed by subject area and by title.

"Give & Take" Series. Bloomington, IN: Agency for Instructional Television, 1982. (Twelve 15-minute television and film programs.)

This series is designed to improve personal economics instruction in the schools. The twelve 15-minute programs, used in conjunction with follow-up activities, will help students improve their economic reasoning and decision-making skills. Topics include such areas as public goods and services, supply and demand, and competition. The series enables teachers of many disciplines to incorporate the program within the existing curricula. Each program is designed to stand alone and may be used in any order. Suggested activities and discussion questions can be easily adapted to a variety of learning situations. Although designed for the 8th, 9th, and 10th grades, students at other levels can benefit from the series. The series is also available on loan from the Central Ohio Economic Education Center, College of Education, The Ohio State University, Columbus, Ohio 43210.

Gwyn, B.; Gwyn, J. K.; Sander, B. R. *The Business of Oral Communication—20 Audio Cassettes*. Cincinnati: South-Western Publishing Co., 1980.

This instructional material is designed to equip students with the basic oral communication competencies necessary for success in their business and personal lives. The package consists of a series of audiocassettes in three modules. A study guide or workbook is available for each module. Each module is self-contained and can stand alone as a unit of study.

- *Module 1: Fundamentals*—Module 1 places emphasis on the important basics of oral communication—proper use of voice, mastery of conversational skills, and listening.

- *Module 2: Person to Person*—In this module, purposeful oral communication between two people in a variety of work situations is emphasized. Instruction focuses on communication by telephone and person-to-person communication in interview situations.

- *Module 3: Selling, Speaking, Meeting—This module develops the art of oral communication in three specific areas: selling; making formal presentations; and participating in and leading the small-group business meeting.*

Hannaford, Alonzo. Job Responsibilities. Developed by Interpretive Education. Mount Kilso, NY: Guidance Associates, n.d.

This program of two filmstrips, one cassette, a library kit, and teacher's guide shows students what it means to be a good employee. The program emphasis is on key skills: the importance of following instructions, cooperating with other workers, and developing good work habits. The employer's responsibilities also are covered: providing clear job description, explaining how the job has to be done, and defining the expected level of performance.

Watts, Michael, ed. "The People on Market Street." Developed by the Indiana Council for Economic Education. West Lafayette, IN: Purdue Research Foundation, 1983.

"The People on Market Street" film series and accompanying student activities workbook are designed for instructors who do not have extensive training in economics. The films can be used in any order, and many of the activities from the workbook can also be used with other films and audiovisual packages, or even independently. This series is available on loan from the Central Ohio Economic Education Center, The Ohio State University, Columbus, Ohio 43210. Titles of the films follow:

- #1 - "Scarcity and Planning"
- #2 - "Cost"
- #3 - "Demand"
- #4 - "Supply"
- #5 - "Market Clearing Price"
- #6 - "Wages and Production"
- #7 - "Property Rights and Pollution"

Koeninger, J.; Williams, G.; Shirley, S.; Elias, K.; and Harris, M. *Jasonville USA: The Leadership Simulation*. Oklahoma City: The Leadership Development Institute, 1984.

Jasonville USA, a comprehensive leadership development program, provides a variety of training tools for use in classrooms or workshops. The simulation exposes students to many situations in advance of actual leadership assignments; graduates of the program should approach leadership assignments with more confidence and with several leadership tools in order to perform more effectively. *Jasonville USA* is a comprehensive program that, when used in its entirety, would take 80-100 hours to present; this time can be shortened by selecting modules and situations that target a particular need or fit a required time period. The simulation contains 10 modules including: listening, group decision making, planning, people and team building, communications and public relations, and so forth. It uses filmstrips, role playing, oral and written communication techniques, and structured activities to implement each module. A leader's guide is included.

Principles of Management. Austin: Extension Instruction and Materials Center, The University of Texas at Austin, 1983.

Principles of Management is a set of 15 color videotapes covering core competencies in the management domain. Each tape is available in any format (3/4", VHS, or Beta) and includes self-study packets for individual and group instruction. Designed for postsecondary, some of the 20- to 30-minute tapes could also be used at the secondary school level.

Tape 1: "The Job of Management"
Tape 2: "Approaches to Management Thought"
Tape 3: "The Manager's Environment"
Tape 4: "Managerial Decision Making"
Tape 5: "Planning: The Primary Function"
Tape 6: "Planning: The Process"
Tape 7: "Organizing: The Structuring Function"
Tape 8: "The Informal Organization"
Tape 9: "Staffing: Matching People to Jobs"
Tape 10: "Staffing: Developing the Employee"
Tape 11: "Leadership: Working with People"
Tape 12: "Motivation: Why Employees Work"
Tape 13: "Communication: The Thread of Unity"
Tape 14: "Change and Conflict"
Tape 15: "Controlling: The Thermostat"

The Video Source Book. 5th ed. Syosett, NY: The National Video Clearinghouse, n.d.

The Video Source Book features more than 35,000 programs currently available on video from more than 700 sources. The book is divided into five major sections: (1) videodisc index, (2) program listings, (3) main category index, (4) subject category index, and (5) video program sources index. Acquisition availability for each program is explained; options range from rental to purchase to loan or even duplication of the program.

Cooperative Education

Humbert, J. T., and Woloszyk, C. A. *Cooperative Education*. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1983.

This resource examines the pivotal roles, activities, and legislation involved in co-op education, with special attention given to the role of the program coordinator. It presents a framework for step-by-step planning and implementation. Also discussed are the benefits in co-op programs for students and employers and recommendations to improve co-op education in the future.

Stull, W. A., and Zedlitz, R. H. *Cooperative Work Experience Manual*. Cincinnati: South-Western Publishing Co., 1984.

This text-workbook takes students from the first day on their co-op job through a series of 34 work-related activities designed to help them become more employable. The activities focus on tasks such as evaluating progress, communicating at work, and management of time and money. The students become active participants in the learning process by helping to structure the learning experiences on the job. This text-workbook can be used as the primary focus of a co-op work experience class or on an individualized basis outside the structured classroom.

Career Planning

Mr. James O'Hara, operations personnel manager of the Matsushita Industrial Company in Franklin Park, Illinois, suggests that electronics instructions **should not overlook career planning**. In recent correspondence, Mr. O'Hara writes that "While I realize this material is designed to be a course in itself, if some of it could be injected into the electronics curricula, it may encourage students to set long-term goals." Mr. O'Hara, who also is associated with several community high schools and with Triton College, observes that many students—as well as some employees—are interested only in short-term goals. "They sometimes are looking for a quick way to get into the work force or are looking to quickly improve their economic status if they are presently employed." Hence, he recommends that vocational and technical instructors impress upon their students that completing schooling and entering the work force is not the end of the line. Instead, "They must be made aware that planning for their future must be ongoing."

A great many resources exist for career planning. We could not begin to list all of them. Here is one that Mr. O'Hara suggests would be valuable for electronics teachers.

Stege, L. E. *Career Planning*. Boone, NC: Center for Instructional Development, Appalachian State University, 1981.

This resource, which includes numerous practical exercises, focuses on the following career planning topics: self-awareness (decision making, beliefs, values, skills, and personality); career awareness (work values, career information, and evaluation of alternatives); setting goals (future life-styling); and overcoming barriers (maintaining commitment, being assertive, managing time, and developing support).

Resources on Labor, Business, and Industry Contacts

Quality of work life education has been going on in labor, business, and industry for several years. Many companies are making an effort to facilitate the development of nontechnical skills in all levels of their hierarchy. Some of the larger companies have developed their own resources to teach these skills and to aid their employees in group problem solving. Resources developed and used by these groups could prove useful to vocational and technical educators. Therefore, you should consider labor unions and businesses in your area in order to obtain materials and guidance that could prove useful. A brief sampling of some of the unions and companies that are currently involved in the QWL process is as follows:

COMPANIES	UNIONS
• American Telephone and Telegraph (ATT)	• Communications Workers of America
• Bendix	• International Associations of Machinists and Aerospace Workers
• General Motors	• United Auto Workers
• Chrysler	• United Steelworkers of America
• Dana	• International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America
• Rockwell International	
• Ohio Bell	• United Food and Commercial Workers International Union

University Associates also publishes reference materials in this area. Suggested titles from this source are *Process Politics: A Guide for Group Leaders*, *A Trainer's Manual for Process Politics*, *Quality Circles: A Strategic Approach*, and *Making Meetings Work: A Guide for Leaders and Group Members*.

Several large organizations, supported by business and industry, also have done work in the area of economic education. Several of these more important organizations are described next.

The Joint Council on Economic Education, 1212 Avenue of the Americas, New York, NY 10036

This organization aims to improve and expand the teaching of economics in the schools and to improve the quality of economic teaching. Part of the structure of the Joint Council is the affiliate State Joint Councils; within each State Joint Council are one or more Centers for Economic Education. Various instructional materials are available.

The Advertising Council, 825 Third Avenue, New York, NY 10022

The Advertising Council has developed a free booklet entitled "The American Economic System . . . and Your Part in It." It has now established a new campaign based on the question: "How High is Your E.Q.?"

Chamber of Commerce of the United States, 1615 H Street, N.W., Washington, DC 20062

The national chamber provides tools and techniques for use in programs sponsored largely by local and State chambers. These materials generally are available for a fee to members and students, business and civic groups.

National Association of Manufacturers, 1776 F Street, N.W., Washington, DC 20062

The National Association of Manufacturers is currently involved in economic education programs through a tax-exempt organization called the Foundation for Economic Freedom.

American Management Associations, 135 West 50th Street, New York, NY 10020

The AMA offers a number of relevant materials in the area of interpersonal skill development.

In addition, many industries have their own specific organization, which can be identified by using the following resource: *National Trade and Professional Associations of the United States*, Columbia Books, Inc., 777 14th Street, N.W., Washington, DC 20005.

Additional information may also be obtained from the American Society of Association Executives, 1517 I Street, N.W., Washington, DC 20005 or the Trade Association Division, Chamber of Commerce of the United States, 1615 H Street, N.W., Washington, DC 20062.

Important Addresses

This list includes the addresses of the publishers and other agencies cited in the resource sections.

Addison-Wesley Publishing Company
One Jacob Way
Redding, Massachusetts 01867

Agency for Instructional Television
P.O. Box A
Bloomington, Indiana 47402

American Association for Vocational Instructional Materials
University of Georgia
120 Driftmier Engineering Center
Athens, Georgia 30302

American Society for Quality Control
230 West Wells Street
Milwaukee, Wisconsin 53203

Appalachian State University
Center for Instructional Development
Boone, North Carolina 28608

Association for Supervison and Curriculum Development
5999 Stevenson Avenue
Alexandria, Virginia 22304

Charles C. Merrill Publishing Company
1300 Alum Creek Drive
Columbus, Ohio 43216

Guidance Associates, Inc.
Box 3000
Mount Kisco, New York 10549

Harper and Row Publishers, Inc.
10 East 53rd Street
New York, New York 10022

Houghton Mifflin Company
Two Park Street
Boston, Massachusetts 02108

Instructional Materials Laboratory
The Ohio State University
112 Townshend Hall
Columbus, Ohio 43210

Leadership Development Institute, Inc.
4300 Highline Blvd.
Oklahoma City, Oklahoma 73108

McGraw-Hill Book Company
1221 Avenue of the Americas
New York, New York 10020

Media Referral Service
P.O. Box 3586
Minneapolis, Minnesota 55403

Mid-America Vocational Curriculum
Consortium
1515 West 6th Avenue
Stillwater, Oklahoma 74074

National Center for Research
in Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, Ohio 43210-1090

National Science Foundation
1800 G Street, NW
Washington, DC 20550

National Video Clearinghouse, Inc.
100 Lafayette Drive
Syosett, New York 11791

Oklahoma State Board of
Vocational-Technical Education
1500 West 7th Avenue
Stillwater, Oklahoma 74074

Oregon State Education Department
700 Pringle Parkway, SE
Salem, Oregon 97310

Prentice-Hall, Inc.
Route 9W
Englewood Cliffs, New Jersey 07632

Purdue Research Foundation
Purdue University
West Lafayette, Indiana 47907

R. R. Bowker Company
205 East 42d Street
New York, New York 10017

Science Research Associates, Inc.
155 North Wacker Drive
Chicago, Illinois 60606

South-Western Publishing Company
5101 Madison Road
Cincinnati, Ohio 45227

University Associates, Inc.
8517 Production Avenue
San Diego, California 92121

University of Maryland
Department of Industrial Education
College Park, Maryland 20742

University of Texas at Austin
Extension, Instruction and Materials Center
Austin, Texas 78712

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• *Skills for the Changing Workplace: A Marketing Educator's Guide*	RD 253	$8.00
• *The Changing Workplace: Implications of Quality of Work Life for Vocational Education*	RD 249	$7.25
• *Sharing Resources: Postsecondary Education and Industry Cooperation*	RD 203	$10.00
• *Building Basic Skills: Models for Implementation*	SN 41	$5.75
• *Job-Related Basic Skills: Cases and Conclusions*	IN 285	$4.75

ORDERING INSTRUCTIONS

To order additional copies, please use order number and title. Orders of $10.00 or less should be prepaid. Make remittance payable to the National Center for Research in Vocational Education. Mail order to:

The National Center for Research
in Vocational Education
National Center Publications, Box F
1960 Kenny Road
Columbus, Ohio 43210–1090

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